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DECEMBER

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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Benign Giant Cell Tumor—*Hector*
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G. G. PRITCHARD, D.D.S., Buffalo, N. Y.
Vice President of the American Dental Association

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Original Communications

WROUGHT GOLD WIRE ALLOYS: PHYSICAL PROPERTIES AND A SPECIFICATION*

By GEORGE C. PAFFENBARGER,† D.D.S.; WILLIAM T. SWEENEY,† A.B., and AARON ISAACS,‡ B.S., Washington, D. C.

THE purpose of this study of wrought gold wire alloys was to survey the physical and chemical properties of the commercial alloys and to draw up a tentative specification with this investigation as a guide. This paper will confine itself to wrought wires which are used in prosthesis for clasps, bars, tangs, etc., and to those used in orthodontia. The investigation was undertaken as part of the cooperative work on dental materials by the Bureau of Standards and the American Dental Association.

PREVIOUS WORK

The composition and physical properties of several wrought gold alloys were reported by R. L. Coleman[1] in 1928. The test procedure and equipment as described by him have been used to a large extent in this study. In 1928, Wilmer Souder[2] first suggested definite physical and chemical requirements for this type of material. After the publication of these requirements, marked improvement in these materials was noticed, until, at the present time, materials with very much improved prop-

*A Report to the Research Commission of the American Dental Association.

*Publication approved by the acting director of the Bureau of Standards of the U. S. Department of Commerce.

*Read before the Section on Partial Denture Prosthesis at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

†Research associate of the American Dental Association at the National Bureau of Standards.

‡Associate chemist, Bureau of Standards.

1. Coleman, R. L.: Physical Properties of Dental Materials, Bur. Stan. J. Res., December, 1928, p. 867. (Available only from Supt. of Documents, Washington, D. C., at 35 cents a copy.)

2. Souder, Wilmer: Summary of Reports on Dental Materials, J. A. D. A., 15:627 (April) 1928.

erties can be readily obtained and with no increase in cost. An excellent history of the physical testing of dental materials and especially of dental golds is given in an article by Walter S. Crowell.[3]

The present paper continues the preliminary report[4] of this work.

SELECTION OF ALLOYS FOR TEST

The alloys were procured direct from the manufacturer under a loan agreement whereby all scrap and analytic residues would be returned and payment made for all unavoidable losses. The following paragraph is from our letter to the manufacturer relative to the procurement of specimens:

> If you care to supply samples, we would like to have specimens of your alloy which you feel to be best for orthodontia arch wires and, if you care to submit another alloy, either one recommended for wrought clasps or in a different price range than the first. With the samples we wish to have stated the heat treatment which you feel will leave the alloy in the best physical condition for use in the mouth.

TABLE 1.—COMPOSITION OF DENTAL WROUGHT GOLD ALLOYS
(PER CENT BY WEIGHT)

Alloy No.	Gold	Silver	Copper	Platinum	Palladium	Nickel	Zinc	Iron	Iridium	Manganese	Tin
A	57.6	4.3	11.7	17.2	8.9	.....	0.10	0.02	0.13	.....	.....
B	64.3	5.2	10.5	16.7	2.2	.....	1.00	0.02	.....	.....	0.11
C	58.9	7.0	13.3	16.5	4.4	.....	0.05	.....	.....	.....	.....
D	54.5	6.2	13.0	17.7	7.2	.....	1.20	.....	0.20	.....	.....
E	60.0	7.8	12.8	18.0	1.5	.....	0.06	.....	.....	.....	.....
F	54.6	7.1	12.3	17.2	7.3	.....	1.50	0.06	.....	.....	.....
G	66.2	11.1	9.0	10.5	1.9	.....	1.00	.....	0.20	.....	.....
H	58.8	8.5	12.9	17.3	2.6	.....	.....	.....	.....	.....	.....
I	54.3	7.9	12.5	17.0	7.1	.....	1.20	.....	.....	.....	.....
J	58.3	7.5	14.1	16.2	3.8	.....	0.06	.....	.....	.....	.....
K	60.4	15.2	9.0	15.5	.....	.....	.....	.....	.....	.....	.....
L	68.1	10.2	13.9	5.0	2.8	.....	.....	.....	.....	.....	.....
M	54.9	14.3	10.1	14.8	5.2	0.04	0.74	.....	.....	.....	.....
N	63.1	9.1	13.5	6.9	4.9	2.0	0.53	.....	.....	.....	.....
O	74.8	.....	1.9	.....	.....	18.4	4.30	0.20	.....	0.4	.....
P	63.2	14.9	11.3	10.6	.....	.....	.....	.....	0.10	.....	.....
Q	61.9	13.0	12.5	7.9	3.9	.....	0.70	.....	.....	.....	.....
R	63.2	12.4	14.9	4.3	4.5	.....	0.60	.....	.....	.....	.....

The following alloys were supplied by their respective manufacturers, to whom we are greatly indebted for their cooperation: Aderer No. 1, Aderer No. 4; Baker Q-A, Baker 12 per cent; Deepep; Jelenko Orthoflex, Jelenko Service Orthoflex; Ney Oro — Elastic No. 3, Ney Oro — Elastic No. 4; Spyco No. 2, Spyco No. 3; Stern No. 2657; Vernon-Benshoff No. 2, Vernon-Benshoff No. 3; Williams No.

3. Crowell, W. S.: Development of Physical Testing of Dental Materials and Specifications for Testing Methods, J. A. D. A., 19:87, (Jan.) 1932.

4. Taylor, N. O.; Paffenbarger, G. C., and Sweeney, W. T.: Study of Wrought Gold Alloys: Preliminary Report, J. A. D. A., 19:410 (March) 1932.

2, Williams No. 7; S. S. White Gold-Platinum and S. S. White Metalba.

TEST METHODS

The test methods used for determining the physical and chemical properties are described below.

Chemical Composition. — The methods, which were those used in the analysis of inlay casting golds,[5] are described by Swanger[6] in his analysis of dental golds.

Table 1 gives the chemical composition of the alloys. The alloys are listed alphabetically according to the decreasing order of their gold plus platinum group metals content. The order is not the same as the order in which the trade names are given.

Physical Properties. — The physical properties of each alloy was determined under four conditions as follows: (1) as received; (2) quenched (placed in an oven at 700 C. [1300 F.] for ten minutes and immediately quenched in water at room temperature); (3) "oven-cooled" (quenched as described, then placed in an oven at 450 C. [840 F.] for two minutes and uniformly slowly cooled to 250 C. [480 F.] in thirty minutes); (4) given the heat treatment recommended by manufacturer as affording the most desirable physical properties. (Table 7.)

Hardness Determination. — Since the specimens were either round or square

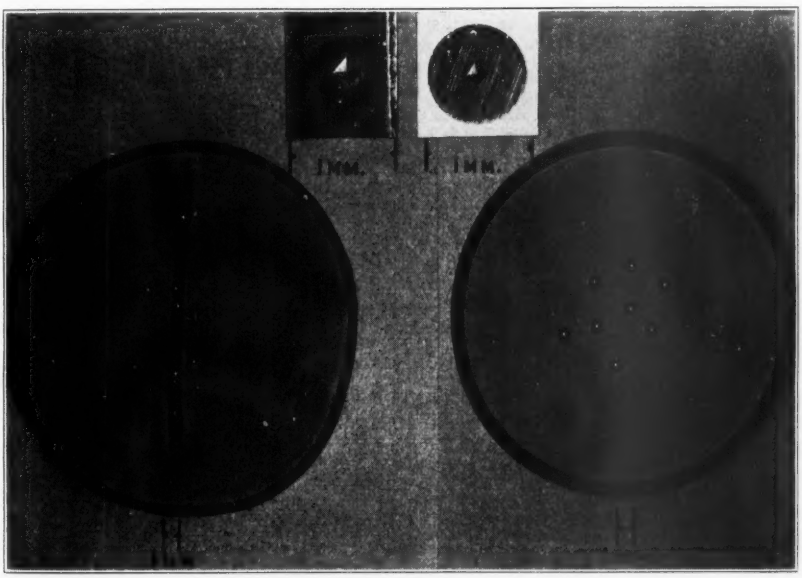


Fig. 1.—Typical indentations used in determining Vickers hardness numbers on 0.040 inch wire.

5. Taylor, N. O.; Paffenbarger, G. C., and Sweeney, W. T.: Inlay Casting Golds: Physical Properties and Specifications, J. A. D. A., 19:36-53 (Jan.) 1932.

6. Swanger, W. H.: Analysis of Dental Gold Alloys, Bur. Stan. Sc. Paper No. 532. (Available only from Supt. of Documents, Washington, D. C., at 10 cents a copy.)

TABLE 2.—PHYSICAL PROPERTIES OF DENTAL WROUGHT GOLD ALLOYS

Alloy	Gold+Platinum Group Weight	Fusion Temperature Wire Method		Vickers Hardness Numbers (10 Kg. load)				Elastic Limit#				Ultimate Tensile Strength				Increase from Quenched to "Oven Cooled"	Elongation in 2 Inch Gage Length				Strain§ "Oven-Cooled"	Alloy
				As Received	Quenched*	Oven-Cooled†	Mfgr's Heat Treatment‡	As Received	Quenched*	Oven Cooled†	Mfgr's Heat-Treatment‡	As Received	Quenched*	Oven-Cooled†	Mfgr's Heat Treatment‡		As Received	Quenched*	Oven Cooled†	Mfgr's Heat Treatment‡		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	Per Cent	Fahrenheit	Centigrade					Lb. Per Sq. In.	Lb. Per Sq. In.	Lb. Per Sq. In.	Lb. Per Sq. In.	Lb. Per Sq. In.	Lb. Per Sq. In.	Lb. Per Sq. In.	Lb. Per Sq. In.	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Inch Per Inch	
A	83.8	1998	1092	267	217	231	219	109,500	73,000	77,500	74,500	132,000	105,500	118,000	115,000	12	2.0	21.0	20.5	20.5	.....	A
B	83.2	1861	1061	226	226	324	272	91,500	78,500	117,000	102,000	129,000	106,500	164,000	133,500	54	15.5	20.5	7.5	15.0	0.0075	B
C	79.8	1877	1025	272	236	322	230	110,000	93,000	134,000	79,000	142,000	121,500	174,000	121,500	43	14.5	16.5	8.5	20.5	0.0071	C
D	79.6	1911	1044	330	247	367	349	120,500	83,500	131,500	131,000	161,000	119,000	173,000	177,500	45	24.0	20.0	7.5	12.5	0.0067	D
E	79.5	1834	1001	256	229	336	298	112,500	84,500	135,500	105,500	135,500	117,500	178,000	139,500	52	4.5	15.5	4.5	8.5	0.0078	E
F	79.1	1882	1028	268	249	362	295	107,500	84,500	140,500	117,500	143,500	120,000	184,000	152,000	53	11.5	20.5	6.5	14.5	0.0067	F
G	78.8	1780	971	215	210	289	...	68,000	65,500	103,000	...	114,000	100,000	144,000	...	44	20.0	14.0	5.0	....	0.0093	G
H	78.7	1850	1010	278	233	353	283	119,000	85,000	144,000	119,500	150,000	120,000	182,500	151,000	52	13.0	17.5	3.5	14.0	0.0069	H
I	78.4	1893	1034	302	224	367	325	117,500	77,500	136,500	124,500	156,500	115,000	183,000	163,500	59	5.0	23.5	5.0	11.5	0.0068	I
J	78.3	1872	1022	263	215	332	....	91,000	72,000	123,500	...	119,000	107,500	172,500	...	60	18.5	22.5	6.5	....	0.0071	J
K	75.9	1801	983	237	197	252	....	95,500	63,500	92,500	...	132,500	99,500	123,000	...	29	1.5	18.5	11.0	....	.....	K
L	75.9	1731	944	238	174	292	265	81,000	50,000	102,000	95,500	116,000	87,000	133,500	135,000	59	17.5	32.0	6.5	12.0	.....	L
M	74.9	1863	1017	266	213	323	306	107,000	77,000	129,000	131,000	140,000	109,500	167,000	163,500	52	8.0	19.0	5.5	7.5	0.0074	M
N	74.9	1742	950	322	230	346	322	125,000	73,500	129,500	113,000	168,500	112,000	170,000	157,500	52	6.0	19.5	4.0	3.5	0.0074	N
O	74.8	1688	920	251	261	287	307	95,000	92,000	117,000	124,500	133,000	128,500	116,000	157,000	14	14.0	16.0	6.5	6.0	0.0068	O
P	73.9	1731	944	257	205	264	294	99,000	80,000	93,000	99,000	128,500	111,500	143,000	147,000	33	6.0	15.0	2.0	3.5	.....	P
Q	73.7	1765	963	259	203	317	...	93,000	68,000	116,500	...	119,500	104,000	155,500	...	50	10.0	21.5	3.5	....	0.0083	Q
R	72.0	1711	933	209	173	305	249	55,500	53,500	105,000	88,500	97,500	86,500	143,000	122,000 117,000	65	25.0	34.5	4.5	11.0 14.5	0.0097	R

*Placed in furnace at 700 C. for ten minutes, immediately quenched in water at room temperature.

† Oven cooled 450-250 C. in thirty minutes after quenching as above.

‡ Compare Table 7.

#Lowest load at which deformation rate equals or exceeds 1.25 times initial rate.

§ Strain between 20,000 and 125,000 pounds per square inch on "oven-cooled" specimens.

wire with a 0.040 inch lateral dimension, they were too small to use for the determination of Brinell hardness numbers. Consequently, the Vickers hardness numbers were determined.

This apparatus is so constructed that the microscope used to measure the diagonals of the indentation made by a diamond pyramid can also be used to dental laboratories do not have, there is no hardness requirement in the specification. Furthermore, there appears to be a fairly definite relation between hardness and other more readily measured properties, as will be seen later. The hardness values were determined as they served as a check on some of the other properties, notably ultimate tensile

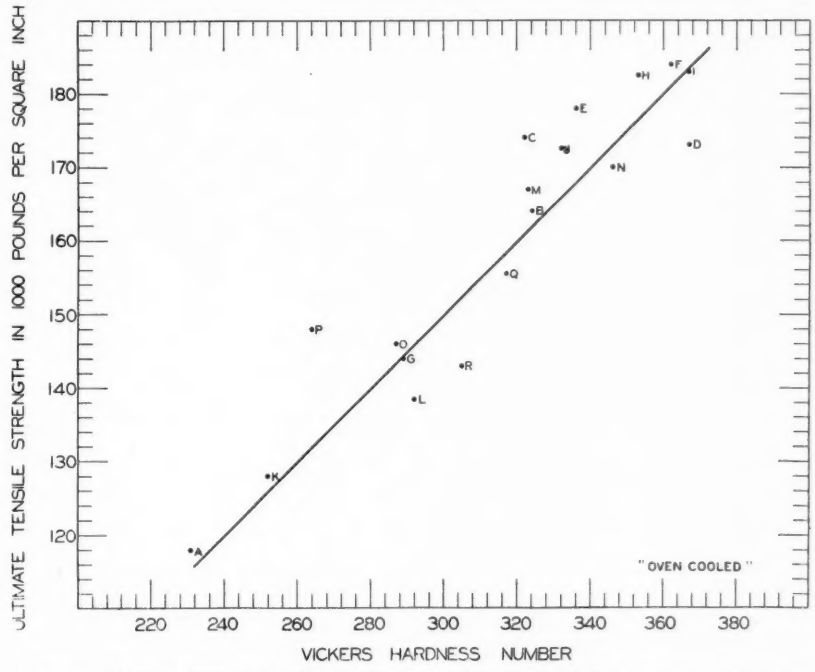


Fig. 2.—Relation between Vickers hardness numbers and ultimate tensile strength of wrought gold alloys. Line represents the formula U. T. S. (in 1,000 pounds per square inch) times 2 equals V. H. N.

advantage in selecting the exact place on a specimen to make the impression. Figure 1 shows the indentation in both the round and square wire mounted in sulphur. All hardness observations were made at room temperature. As this type of hardness determination involves the use of expensive equipment which most

strength, and are a rapid and accurate means of determining certain physical changes in the alloys.

Tension Tests.—Tensile specimens of wrought wire approximately 0.040 inch in diameter and 6 inches long were tested in tension to determine the ultimate tensile strength, the elastic limit and

elongation. Loads were applied by a hand operated Amsler testing machine which could be adjusted to give loads of 0-200, 0-400 and 0-600 pounds for a full scale movement of the indicating pointer. The 0-200 pound range was used for a majority of the specimens. The 0-400 pound range was used for the remainder. The strain was measured by using a double dial extensometer.[4]

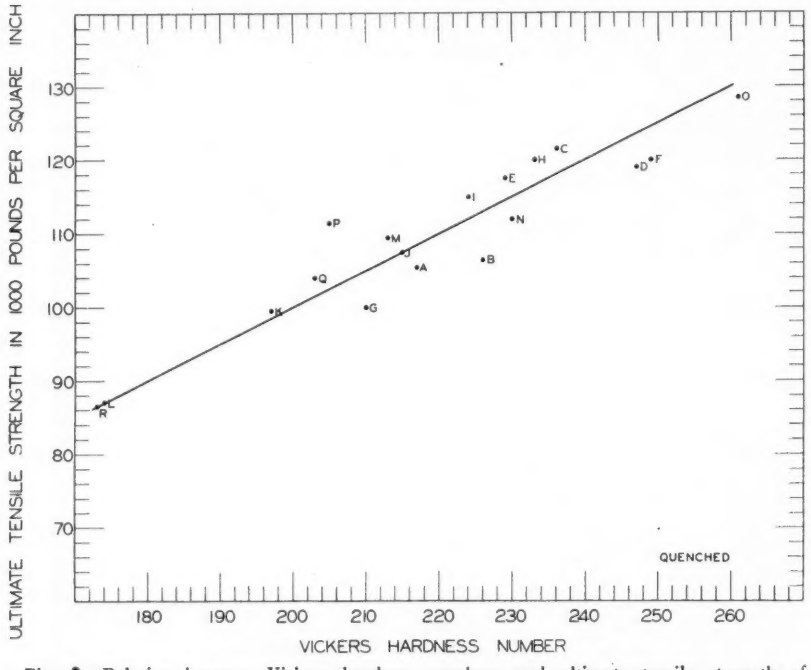


Fig. 9.—Relation between Vickers hardness numbers and ultimate tensile strength of wrought gold alloys. The line represents the formula U. T. S. (in 1,000 pounds per square inch) times 2 equals V. H. N.

Elastic Limit.— Initial loads of 10 pounds (7,960 pounds per square inch) and 20 pounds (15,920 pounds per square inch) were used according to the strength of the wire. This was sufficient to hold the wire straight and rigid while the extensometer was adjusted. The load was then increased by increments of 10 pounds until the stress was approximately within 60 pounds (47,760 pounds per square inch) of the "elastic limit." From this point on, the stress was applied in increments of 2 pounds until a decided increase in the deformation was indicated.

The "elastic limit," for the purposes of this paper, is defined as the load at which the deformation produced by a unit load equals or exceeds 1.25 times that observed in the first few increments of load. The values for "elastic limit," summarized in Table 2, were determined from the numerical data by multiplying

the strain for an increment of load below the proportion limit by 1.25 and locating the lowest stress which equals or exceeds this strain. This method is convenient and consistent and also eliminates the personal element in drawing a curve through plotted points on a graph.

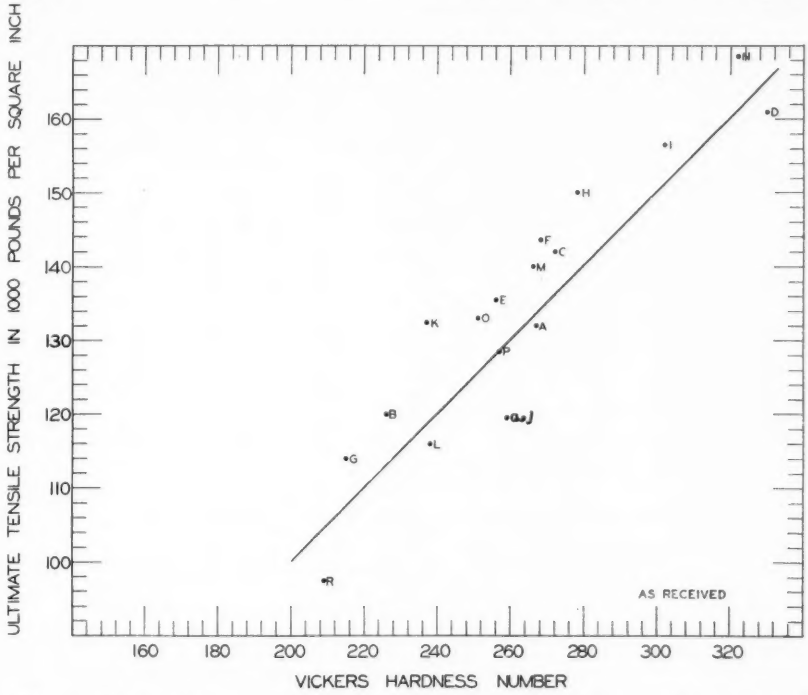


Fig. 4.—Relation between Vickers hardness numbers and ultimate tensile strength of wrought gold alloys. The line represents the formula U. T. S. (in 1,000 pounds per square inch) times 2 equals V. H. N.

These values of "elastic limit" are not the same as the "yield point" determined by the method described in the specification.

Ultimate tensile strength was obtained by a slow and continuous application of increasing loads until rupture occurred; the time between the initial application of the load and the rupture of the specimen being less than twenty minutes.

Elongation.—This was determined over a 2-inch-gage length. A measuring microscope was used to determine the increase in length over the original 2 inches. Previously, a razor blade was used to gage mark the specimens, but many of these wrought wire specimens were weakened by this method and broke at the gage mark. The following method was substituted: Portions of the wire were coated with a soft wax pencil and a tight silk thread was drawn over

TABLE 3.—EFFECT OF AGING ON WROUGHT GOLD ALLOYS

Alloy	Vickers Hardness Numbers			Vickers Hardness Numbers				
	"Oven-Cooled"	"Oven-Cooled" and Aged Six Months at Room Temperature	Difference	Quenched	Quenched and Aged Three Months at at 100 F.	Difference	Same Specimens Aged Forty-eight Hours at 350 F.	Difference
A	231	228	— 3	217	216	— 1	216	0
B	324	313	—11	226	229	+ 3	235	+ 6
C	322	308	—14	236	230	— 6	242	+12
D	367	352	—15	247	253	+ 6	250	— 3
E	336	329	— 7	229	227	— 2	238	+11
F	362	358	— 4	249	254	+ 5	256	+ 2
G	289	291	+ 2	210	234	+24	223	—11
H	353	334	—19	233	238	+ 5	242	+ 4
I	367	364	— 3	224	225	+ 1	235	+10
J	332	318	—14	215	220	+ 5	214	— 6
K	252	250	— 2	197	195	— 2	218	+23
L	292	287	— 5	174	181	+ 7	225	+44
M	323	318	— 5	213	209	— 4	217	+ 8
N	346	335	—11	230	224	— 6	241	+17
O	287	280	— 7	261	256	— 5	258	+ 2
P	264	262	— 2	205	217	+12	233	+16
Q	317	304	—13	203	213	+10	232	+19
R	305	302	— 3	173	184	+11	249	+65

TABLE 4.—EFFECT OF VULCANIZATION ON WROUGHT GOLD ALLOYS

Alloy	"Oven-Cooled"		"Oven-Cooled" and Vulcanized at 160 C. (320 F.)			
			Without Rubber		With Rubber	
	U.T.S. Pounds Per Square Inch	Elongation Per Cent	U.T.S. Pounds Per Square Inch	Elongation Per Cent	U.T.S. Pounds Per Square Inch	Elongation Per Cent
A	118,000	20.5	114,500	22.5	112,000	21.0
B	164,000	7.5	161,500	11.0	160,500	10.0
D	173,000	7.5	173,000	9.0	179,000	10.0
F	184,000	6.5	178,000	6.0	184,000	7.5
G	144,000	5.0	141,500	8.0	141,500	9.0
L	138,000	6.5	137,000	8.5	137,500	8.5
R	143,000	4.5	150,000	5.5	149,500	5.5

the wire which had previously been fastened in a 2-inch-gage block.

Fusion Temperature.—Fusion temperatures were determined by the "wire method" by A. I. Dahl of the pyrometry laboratory of the Bureau. A description of this method is given in a previous publication.[1]

SUMMARY OF DATA

The physical properties of these dental wrought gold alloys are given in Table 2. The data show that there is a considerable range of values in the alloys. The Vickers hardness numbers ranged from 173 on a quenched wire (R) to 367 on "oven cooled" specimens (I and D). Likewise, the "elastic limits" is a definite linear relation between the hardness numbers and the values for ultimate tensile strength. This appears to be true in the cold worked, quenched and hardened ("oven-cooled") conditions. Figures 2-4 demonstrate this relationship. A simple formula (represented by a line on the figures) could be used for estimating either the Vickers

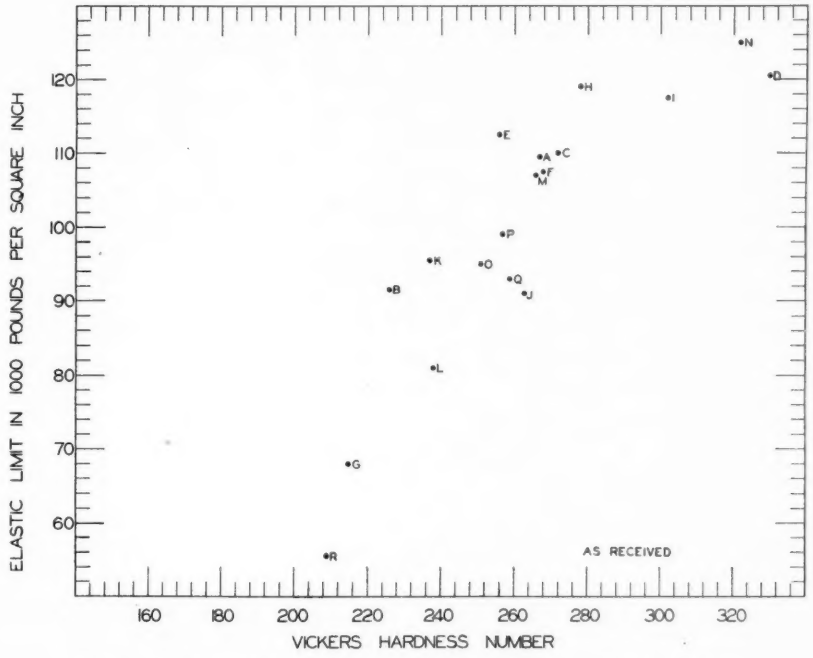


Fig. 5.—Vickers hardness numbers and elastic limit for wrought gold wires.

ranged from 50,000 pounds per square inch on a quenched specimen (L) to 144,000 pounds per square inch on an oven-cooled specimen (H). The ultimate tensile strengths ranged from 86,500 pounds per square inch on the quenched sample (R) to 184,000 pounds per square inch on an oven-cooled specimen (F). It seems apparent that there is a definite linear relation between the hardness numbers and the values for ultimate tensile strength. This appears to be true in the cold worked, quenched and hardened ("oven-cooled") conditions. Figures 2-4 demonstrate this relationship. A simple formula (represented by a line on the figures) could be used for estimating either the Vickers hardness number or the ultimate tensile strength when one is known, thus:

U.T.S. in 1,000 pounds per square inch $= \frac{\text{V.H.N.}}{2}$ or V.H.N. = U.T.S. in 1,000 pounds per square inch $\times$ 2.

The ultimate tensile strength computed from the foregoing formulas agrees with the experimentally observed

values to within 5 per cent on the average. The maximum variation is 11 per cent.

It would seem from the foregoing that the Vickers numbers give a very good indication of the strength, probably within the experimental error of the observations on this type of material. This is in agreement with Petrenko's results on steels.[7]

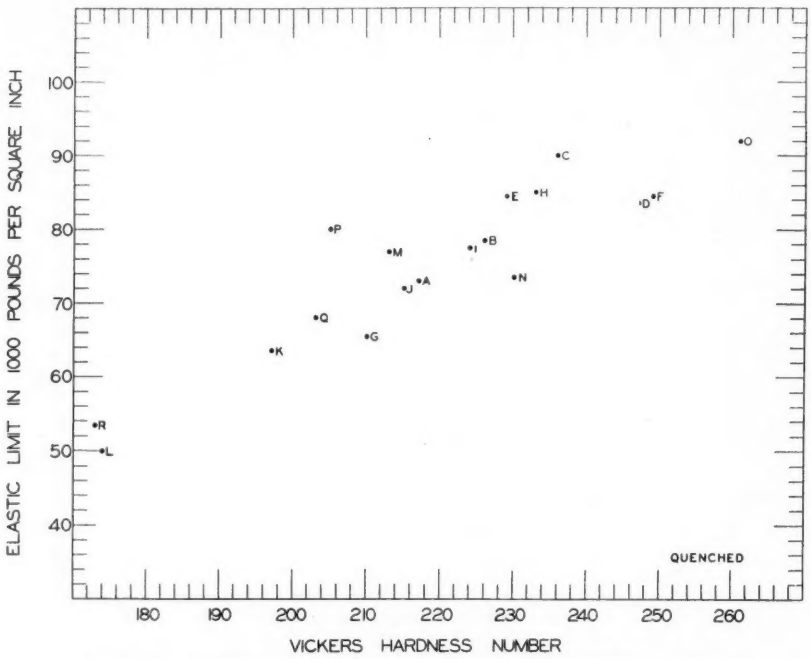


Fig. 6.—Vickers hardness numbers and elastic limit for wrought gold wires.

Figures 5-7, showing the relationship between the hardness determinations and the "elastic limit," would not be expected to show as definite a relation as the ultimate tensile strength. The relationship between the hardness and elongation data (Figures 8-10) was not nearly so regular as that between hardness and ultimate tensile strength. It must be remembered that these relationships cover a considerable spread of composition, as shown in Table 1. The relationship between Vickers hardness numbers and elongation is very nearly linear for a given alloy (Fig. 11), but there seems to be no general relation between these properties for the alloys studied. It is apparent from Figure 11 that the rate of decrease in elongation with increase in hardness (or strength) is not the same for different alloys. In many of the alloys studied, there is a very definite relationship existing between the various properties, including elongation when an individual alloy is

7. Bur. Stan. J. Res., 5:19 (July) 1930.

considered. Two alloys of this type are shown in Figure 11.

Some interesting results were obtained by plotting the ultimate tensile strengths against the elongation, using some published figures of the manufacturers. Figures 12 and 13 show examples of reliable and of questionable data. The published data on alloy O (Fig. 12) are considered questionable, as the tensile strength is raised by a hardening heat treatment ("oven-cooled") from 121,000 to 167,000 pounds per square inch and, at the same time, the elongation is raised from 12 to 13 per cent. Because of these data, a rather extensive series of heat treatments were carried out on this wire, and it was invariably found that when the tensile strength was increased, the elongation dropped, as in Figure 12. The differences in the data of alloy F (Fig. 13) are due to the different heat treatments to which the alloys were subjected and not to unreliable data.

No definite relationships between composition and physical properties were obtained.

Representative stress-strain diagrams of several alloys in the quenched and "oven-cooled" condition are shown in Figures 14 and 15.

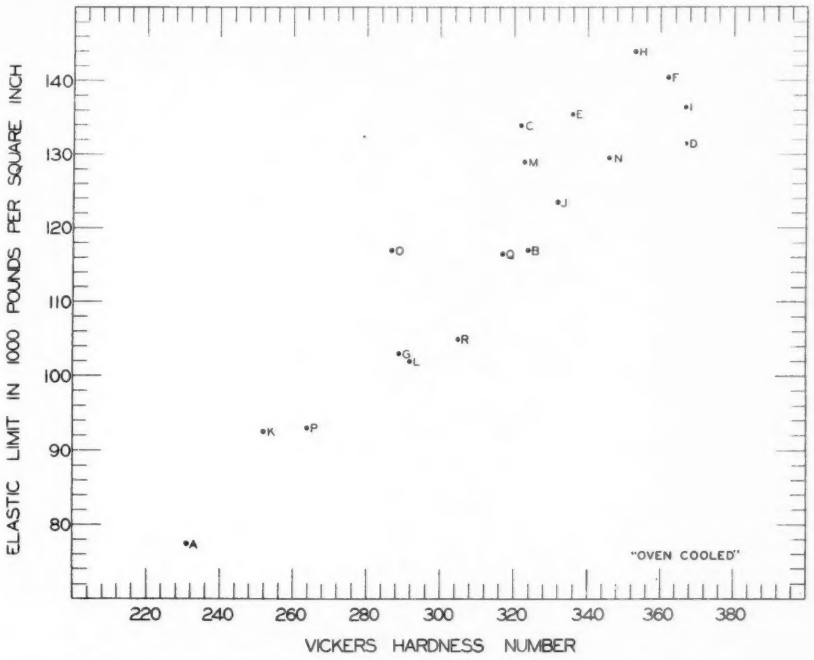


Fig. 7.—Vickers hardness numbers and elastic limit for wrought gold wires.

HEAT TREATMENT

Many of these alloys respond to various heat treatments. Some show a pronounced effect, as alloys L and R, which

increase in ultimate tensile strength 59 per cent and 65 per cent, respectively, from the quenched to the "oven-cooled" condition (Table 2, column 17). The opposite extreme is alloy A, which is practically immune, having only a 12 per cent increase in strength. It has been pointed out[8] that binary alloys of gold-copper, palladium-copper, gold-platinum, platinum-silver and platinum-copper are is a high nickel-white gold, while K and P do not contain palladium. Even though they do contain all of the elements which are susceptible to hardening heat treatments, some cannot be heat-treated appreciably. This is particularly outstanding in the case of alloy A. Alloys A and E were supplied by the same manufacturer. Their compositions are similar, alloy A having 2.4

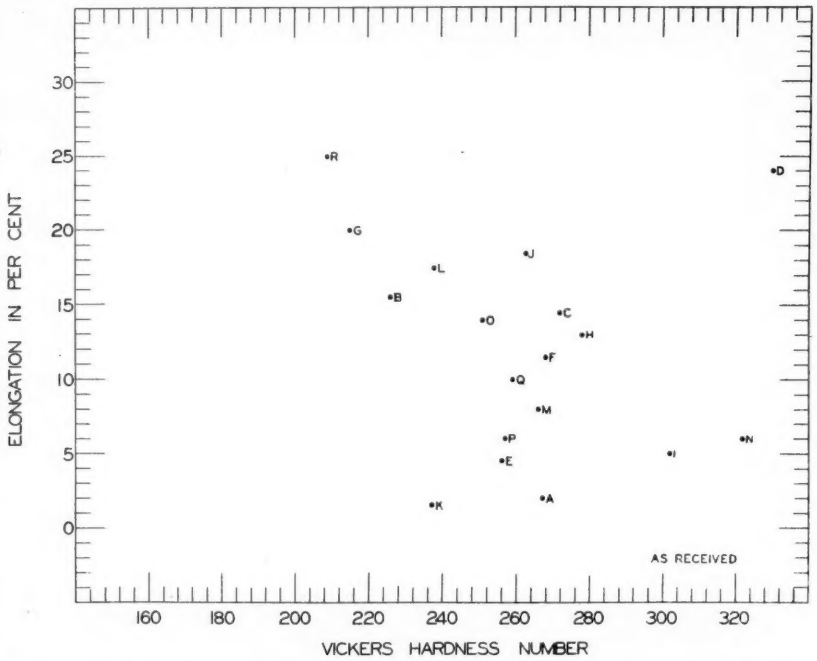


Fig. 8.—Relation between Vickers hardness numbers and percentage elongation for wrought gold alloys.

susceptible to hardening heat treatments. In most of the alloys considered, all of the foregoing elements are present, alloys K, O, P being the exceptions. Alloy O

8. Wise, E. M.; Crowell, W. S., and Eash, J. T.: Rôle of Platinum Metals in Dental Alloys, preprint, American Institute of Mining and Metallurgical Engineers.

per cent less gold than E, 3.5 per cent less silver, 1.1 per cent less copper, 0.8 per cent less platinum, 7.4 per cent more palladium and 0.04 per cent more zinc. It also has 0.13 per cent iridium, which is absent in E. Yet alloy E is very susceptible to heat treatment, its ultimate strength increasing from 117,500 pounds

per square inch in the quenched state to 178,000 pounds per square inch in the "oven-cooled" condition, an increase of about 52 per cent. A, as before stated, has only a 12 per cent increase. A special alloy very similar to A was made by the manufacturer. Its composition was identical with that of A except that the silver content was raised to 6 per cent at the expense of the platinum. This makes the alloy composition similar to alloy F, which can be heat treated very markedly, yet this special 6 per cent silver alloy would respond to a hardening heat treatment about as it had previously.

The gold and copper content of dental golds has often been considered the criterion for judging the ability of the alloy to heat treat. Figure 16 shows this relationship for the alloys studied. Similar plottings of gold-platinum, silver-platinum, palladium-copper and silver-copper did not show any more definite relationship. Using the current theoretical knowledge of precipitation hardening in binary alloy systems, it is almost impossible to predict with any definite certainty the behavior of alloys of the type investigated.

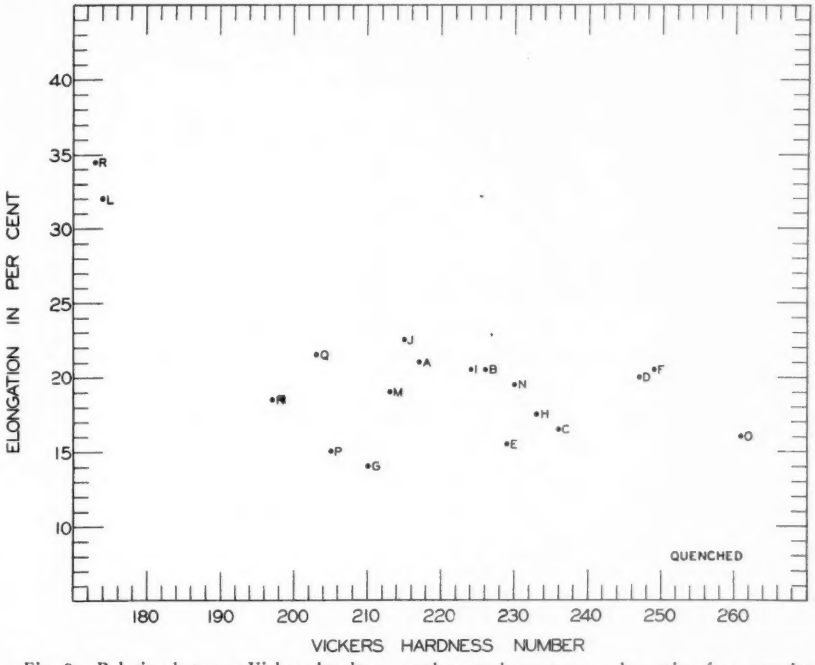


Fig. 9.—Relation between Vickers hardness numbers and percentage elongation for wrought gold alloys.

The question of the permanency of the heat treatments has been discussed in another paper,[9] in which report is made regarding six alloys tested after an interval of two months at room temperature. Four of these alloys were reported

9. Brumfield, R. C.: Precious Metal Alloys, Tr. Am. Soc. for Steel Treating, 19:333-367 (Feb.) 1932.

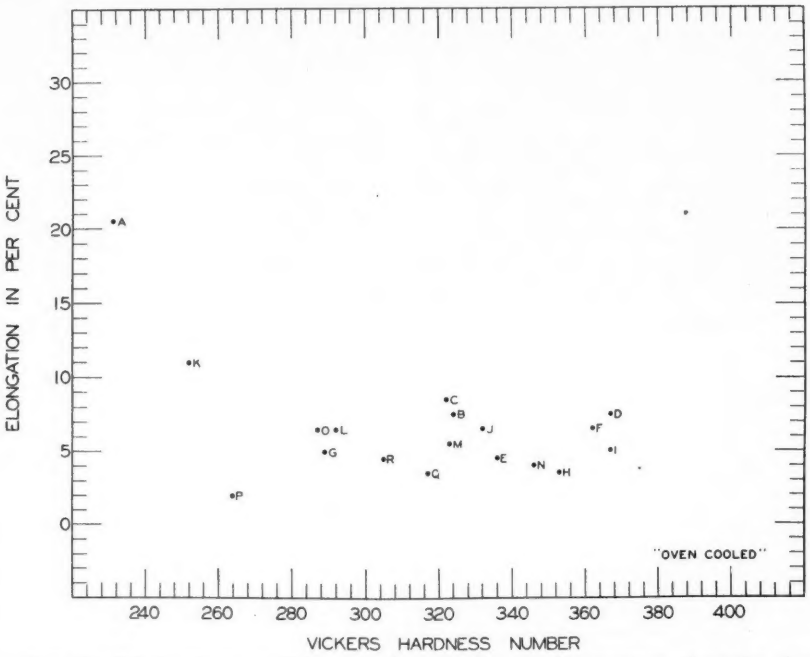


Fig. 10.—Relation between Vickers hardness numbers and percentage elongation for wrought gold alloys.

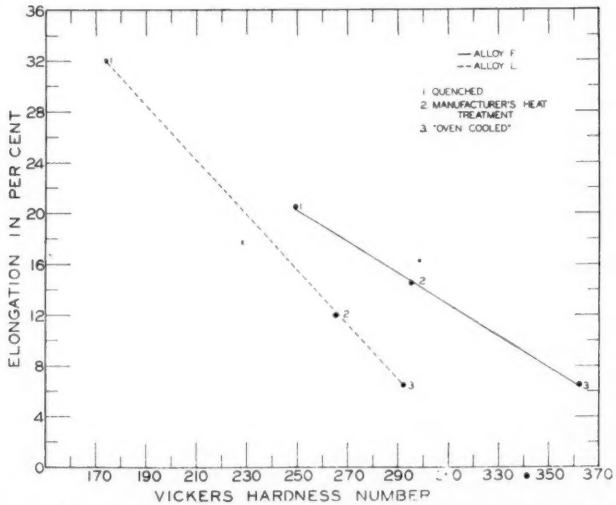


Fig. 11.—Relation between Vickers hardness numbers and percentage elongation for different heat treatment for two wrought gold alloys.

as showing no change in ultimate tensile strength, one a 35 per cent increase and the other a 22 per cent decrease. In view of this statement, it was decided to investigate the alloys under consideration and determine whether a change in the physical properties occurred at room temperature. The Vickers hardness specimens (Fig. 1) which had been "oven-cooled" were ground off and repolished, and were tested again after an interval of approximately six months. The data shown in Table 3 seem to indicate that there may be a slight decrease, but it is so extremely small that it can be considered of no practical consequence, and is probably within the error of the determination.

Some dentists believe that there is a change in the physical properties of

TABLE 5.—EFFECT OF HEAT TREATMENT ON TENSILE PROPERTIES

Alloy	Ultimate Tensile Strength Pounds Per Square Inch	Per Cent of Elongation in 2 Inches	Treatment Quenched in Water from 700 C. and Maintained at Temperature Indicated	
			Temperature (C.)	Time in Minutes
A	118,000	20.5	450-250	30
A	108,000	24.5	475	30
E	178,000	4.5	450-250	30
E	162,000	9.0	425	30
F	184,000	6.5	450-250	30
F	140,500	12.5	425	10
F	154,000	13.0	425	30
F	159,000	11.0	425	60
F	154,000	10.0	425	120
H	182,500	3.5	450-250	30
H	163,500	9.0	425	10
H	169,500	6.5	425	30
H	175,000	4.5	425	60
H	174,000	3.0	425	120
K	128,000	11.0	450-250	30
K	114,000	15.5	375	10
K	125,500	13.5	375	30
K	127,500	11.5	375	60
K	125,000	9.0	375	120
O	128,500	6.5	450-250	30
O	129,000	16.5	375	10
O	134,000	6.0	375	30
O	147,000	4.5	375	60
O	142,000	5.5	375	120
R	143,000	4.5	450-250	30
R	105,500	8.0	300	10
R	111,000	7.0	300	30
R	117,500	7.0	300	60
R	119,500	4.0	300	120

many of these alloys at mouth temperature. Some also think that the quenched alloys harden to such a marked degree that the change could be easily determined by testing in the hands. This would not be possible with the materials used in this investigation. The hardness specimens which had been used in determining the quenched hardness were ground off, repolished and incubated for three months at 38 C. (100 F.) in a constant temperature oven. The data (Table 3) for these tests again show that the changes are too small to be felt by tactile tests. This does not necessarily mean that the dentist's observations were incorrect, as the alloys could have been easily hardened, and very probably were hardened, by cold working in the mouth.

There has been some complaint relative to embrittlement of alloys which were used as clasps or as other portions of dentures and were heated at the temperature and time which are used in curing some of the newer synthetic denture materials. The most severe time-temperature requirement that has been noted for this type of work is 177 C. (350 F.) for forty-eight hours. The quenched hardness specimens which had aged at 38 C. (100 F.) for three months were again ground off, repolished and taken out of their sulphur mounting. They were then heated for forty-eight hours at 177 C. (350 F.) in a constant temperature oven, remounted in sulphur and again polished. With the outstanding exceptions of alloys L and R, there was little effect noted (Table 3.) It is possible that either L or R would become brittle under such treatment, and especially so if they were placed in the vulcanizer in a heat-treated state.

Additional tests were made to determine the effect of the vulcanization process on the properties of some of these alloys. These tests were made on

TABLE 6.—EFFECT OF HEAT TREATMENT ON TENSILE PROPERTIES

Alloy	Ultimate Tensile Strength in Pounds Per Square Inch	Percentage of Elongation In 2 Inches	Heat Treatment	
			Minutes	Temperature (C.)
F	120,000	20.5	10	700
F	111,000	20.5	60	100
F	119,500	20.0	60	300
H	120,000	17.5	10	700
H	124,500	12.0	60	100
H	133,500	11.5	60	250
K	99,500	18.5	10	700
K	93,500	22.0	60	100
K	102,000	21.0	60	250
O	128,500	16.0	10	700
O	124,000	15.0	60	100
O	126,000	10.5	60	300
R	86,500	34.0	10	700
R	74,500	31.5	60	100
R	87,000	6.0	60	200

tensile specimens which had previously been "oven-cooled." The "oven-cooled" condition was selected as no appreciable heating of the metal parts can take place after vulcanization without injuring the vulcanite portion of the denture, and therefore any heat treating that is done must occur before the investing of the case. The specimens were invested in brass tubes. The ones marked "with rubber" had about an inch in the center of the specimen, wound with a strip of unvulcanized rubber before flasking. They were brought up to 160 C. (620 F.) in thirty minutes and held there for two hours and fifteen minutes. The vulcanization process with or without the rubber produced no ill-effects, as disclosed in the data of Table 4, and, in almost all of the alloys used, there was an appreciable increase in the elongation without sacrificing the strength.

As we wished to study further the heat treating susceptibilities of some of these alloys, alloys A, E, F, H, K, O and R were procured from the manufacturers as 0.040 inch square wire. The square wire was selected as it was

TABLE 7.—HEAT TREATMENT RECOMMENDED BY MANUFACTURERS

Alloy	Quenched in Water at Room Temperature		Hardening Treatment		Quench
	Temperature	Time in Minutes	Temperature	Time in Minutes	
A and E	700 C. (1300 F.)	10	450-250 C. (840-480 F.)	15	Air
C	870 C. (1600 F.)	Furnace slowly brought up to 870 C.	430 C. (800 F.)	Not Specified	Air
D	700 C. (1300 F.)	10	450 C. (840 F.)	30	Air
B and F	700 C. (1300 F.)	2	450-250 C. (840-480 F.)	Held at 450 C. for 2 minutes prior to 15 minute cool	Air
H and L	700 C. (1300 F.)	2-5	450-250 C. (840-480 F.)	Held at 450 C. for 1½ minutes prior to 15 minute cool	Air
I and P	700 C. (1300 F.)	Not specified	450 C. (840 F.)	3	Air
M and O	700 C. (1300 F.)	Furnace slowly brought up to 700 C.	450-250 C. (840-480 F.)	Furnace slowly brought up to 450 C. and cooled to 250 C. in 30 min.	Air
N	840 C. (1550 F.)	Not specified	430 C. (800 F.)	Cooled slowly	Air
R	700 C. (1300 F.)	10	340 C. (650 F.)	3	Air or Water
G, K, Q, J	Heat treatment same as "oven-cooled."				

much more convenient (Fig. 1) to mount it and it presented a flat surface on which hardness values could be determined. The particular alloys were selected from the whole group as they had relatively dissimilar composition and properties.

The specimens were given the usual quenching treatment; i.e., held at 700 C. (1300 F.) for ten minutes and immediately quenched in water at room temperature, after which they were given the desired heat treatment, mounted in sulphur, ground and polished. The change produced in the physical state of the alloy was determined by obtaining the Vickers hardness number. Since the melting point of sulphur is not much above 100 C. (212 F.), the specimens treated at 150 C. (302 F.) and below were not mounted. Several hardness specimens of each alloy were prepared and heat treated for sixty minutes at every 50 degree interval from 50 to 600 C. (that is, starting with quenched specimens before each heat treatment). The curves in Figures 17-20 show the effect of these heat treatments on the hardness of the alloys. They give evidence of important physical changes in alloys. These results were further confirmed by tensile and elongation tests. The optimum hardening temperatures were selected from the curves and the specimens "soaked" at different time intervals, as given in Table 5. The values of the "oven-cooled" specimens and those of

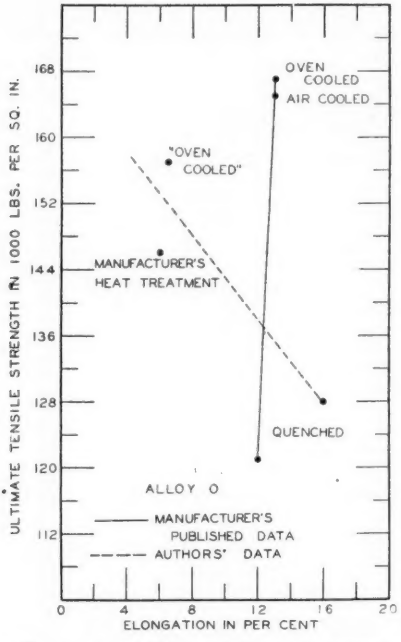


Fig. 12.—Relation between percentage elongation and ultimate tensile strength.

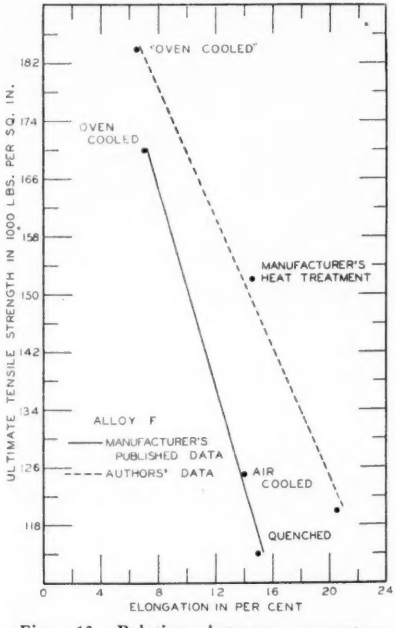


Fig. 13.—Relation between percentage elongation and ultimate tensile strength.

the special hardening treatments are shown (Table 5) to be very dissimilar in some of the alloys considered.

With the exception of R, all of the alloys seemed to be further softened when heat treated at the 50 C. (120 F.) and 100 C. (210 F.) Additional tests on tensile specimens largely confirmed the hardness findings, as shown in Table 6.

The manufacturers in general recommend some form of slow cooling as a hardening treatment. It is apparent from Table 7 that the "oven-cooling" as first used by Coleman[1] has influenced these recommendations. While several of the recommendations have changed the time interval, the temperature range (450 to 250 C.) has been maintained in the majority of the recommendations. Furthermore, the upper limit (450 C.) is given for all but three alloys of the present investigation. The general tendency is to shorten the time, or, in other words, to cool the material more quickly than thirty minutes as used in the pioneer work.

Three manufacturers suggested (alloys D, I, P and R) holding the material at a definite temperature for a specified length of time. In every case, the properties after this treatment were better than the properties of the "oven-cooled" specimens, the ultimate tensile strength being comparable and the elongation much higher. This indicates that the time-temperature relationship could be worked out for each alloy.

The following tentative specifications for dental wrought gold wire alloys is the result of this survey and the opinions and recommendations of the manufacturers, dental schools, government departments and dentists. We believe its use will adequately protect the dentist in his purchases of this type of material.

AMERICAN DENTAL ASSOCIATION
TENTATIVE SPECIFICATION NO. 7
FOR
DENTAL WROUGHT GOLD WIRE ALLOYS

I. Wrought gold wire alloys which are used in prosthesis and orthodontia are considered in this specification.

DETAIL REQUIREMENTS FOR DENTAL WROUGHT GOLD ALLOYS

Gold and Platinum Group Metals Per Cent	Fusion Temperature Wire Method	Ultimate Tensile Strength Pounds Per Square Inch	Yield Point Pounds Per Square Inch	Elongation 2 Inch Gage Length Per Cent	
					"Oven-Cooled"
Minimum 75	Degrees F. Minimum 1,750	"Oven-Cooled" Minimum 150,000	"Oven-Cooled" Minimum 125,000	Quenched Minimum 15	Minimum 4

II. General Requirements: 1. Color. The color of the gold alloys shall be the color specified by the purchaser. This specification applies both to the white golds and to the gold-color alloys. 2. Physical properties. These shall be determined on wrought round wire in the quenched (softened) and in the "oven-cooled" (hardened) condition.

III. Detail Requirements: The detailed requirements are given in the accompanying table.

IV. Methods of Inspection and Test: 1. Composition. The determined values for metallic constituents shall be recorded as the nearest 0.5 per cent. When a determined value falls midway between a half and a whole number, the whole number shall be recorded.

2. Physical properties. These shall be determined on round wrought wire samples: *(a)* quenched: placed in a furnace at 1290 F.

for ten minutes and immediately quenched in water at room temperature; (*b*) "oven-cooled": placed in a furnace at 1290 F. for ten minutes and immediately quenched in water at room temperature, then placed in the furnace at 840 F. for two minutes and uniformly slow cooled to 480 F. in thirty minutes.

An alloy complies with this specification when the values of the physical properties of the average of three or more out of a series of five samples meet the requirements.

3. Yield point. *(a)* The yield point shall be determined on round wrought samples whose diameters are between 0.038 and 0.042 inch. The gage length used shall not be less than 2 inches. An averaging strain gage shall be used. (*b*) An initial load calculated to produce a stress of 20,000 pounds per square inch shall be applied to the "oven-cooled" sample and the strain gage read. The load shall then be increased to the minimum value for yield point (125,000 pounds per square inch) and a second reading taken. The maximum strain permitted between the limits specified is 0.0085 inch per inch. The determined value for strain shall be recorded to the nearest 0.0001 inch per inch. When the determined value falls midway between two numbers, the even number shall be recorded. (*c*) As an alternate method, loads above and below the two limits specified may be applied provided they do not vary the stress by more than 1,000 pounds per square inch from the specified loads. The recorded strain may be determined graphically.

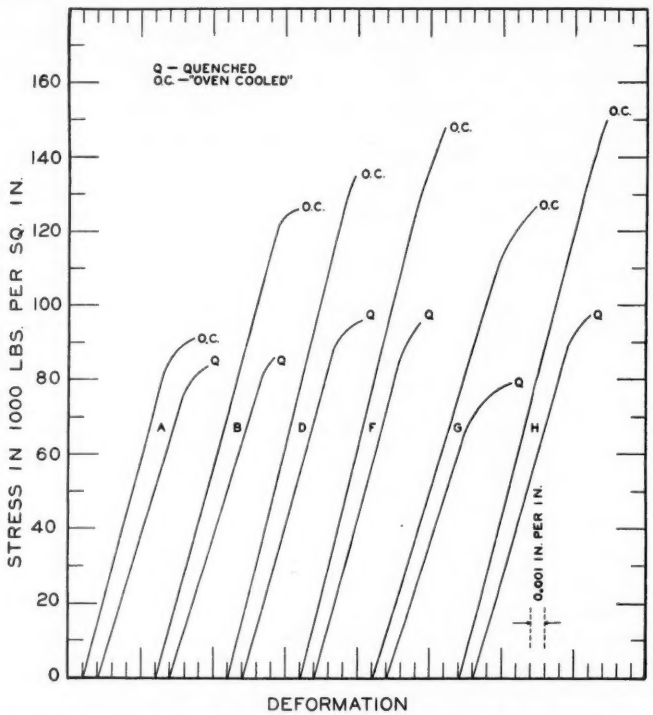


Fig. 14.—Representative stress-strain diagram of alloys of wrought gold wire.

4. Elongation. This shall be determined on the samples used for the test for yield point. The load shall be applied slowly (not more than twenty minutes between initial load and rupture) and continuously after

the strain gage is removed until rupture occurs. Samples which break outside the gage length may be repulled. Elongation shall be measured on a 2-inch-gage length. The determined value shall be recorded to the nearest 0.5 per cent. When the determined value falls midway between a half and a whole number, the whole number shall be recorded.

5. Fusion temperature, wire method. The fusion temperature is the lowest temperature at which a wire from 0.028 to 0.032 inch in diameter and approximately one-sixteenth inch long will break when subjected to a cross bending load of 3 ounces avoirdupois. The heating rate within 100 F. of the breaking point shall be between 10 and 50 degrees per minute. The test is made by fusing or welding the sample under test, between two wires of a platinum, platinum-rhodium thermocouple so that the two welds or fused balls are separated by approximately one-sixteenth inch of wire. The 3-ounce weight is attached to the sample by means of a hook of high fusing noble metal or noble metal alloy. The hook shall have approximately the same diameter as the test sample.

V. Packing: 1. The minimum net weight of the contents shall be marked on each package. 2. Each package shall be marked with a serial number or combination of letters and numbers which shall refer to the manufacturer's records for the particular lot or batch of alloy.

VI. Notes: 1. Guarantee. Manufacturers may indicate that their products comply with these requirements by (*a*) a statement on the package guaranteeing the material contained therein to meet the requirements of this specification, or (*b*) a statement of the chemi-

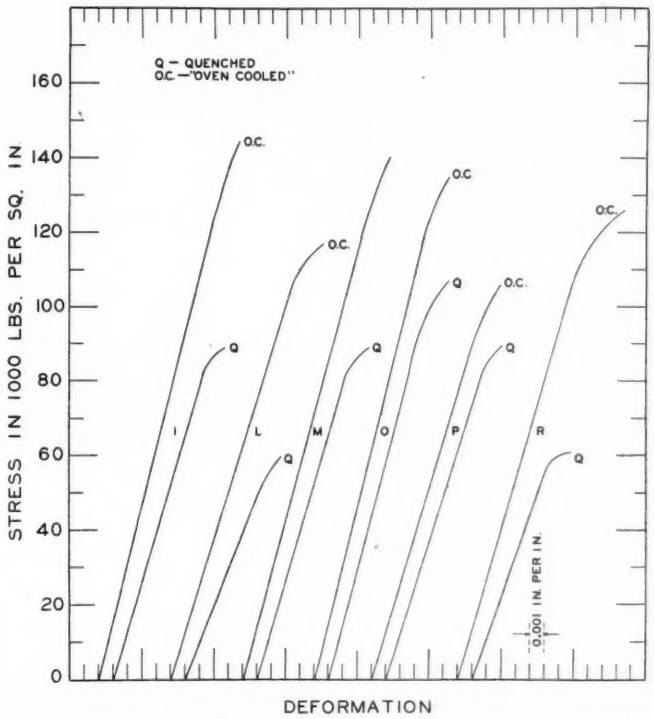


Fig. 15.—Representative stress-strain diagram of alloys of wrought gold wire.

cal and physical properties of the material in such detail as to cover all the requirements specified. 2. Responsibility for any guarantee. All statements or guarantees that products meet this specification are made by manufacturers on their own responsibility. In the event of disagreement between purchaser and manufacturer, the American Dental Association will act in an advisory capacity and will designate testing laboratories having equipment for making tests of dental golds.

Of the alloys included in this investigation, the following meet the requirements of the specification: B, C, D, E, F, I, J and M, representing seven manufacturers. Therefore, it would seem that the profession can be supplied with materials meeting the specification by any progressive manufacturer.

The "oven-cooled" heat treatment used in this specification is not necessarily the best for all or for any of the alloys investigated. Nevertheless, it is included in the specification because it practically assures the user that the alloy will not become brittle from indiscriminate heat treatment such as it often receives in practice. An alloy which has satisfactory properties after "oven-cooling" should withstand such treatments as high-curing temperature, baking in investments and slow cooling from soldering operations. It follows that any wire which withstands this "oven-cooling" will give satisfactory service in actual use. In addition, it would be very beneficial to the users of this material, if the manufacturers would sup-

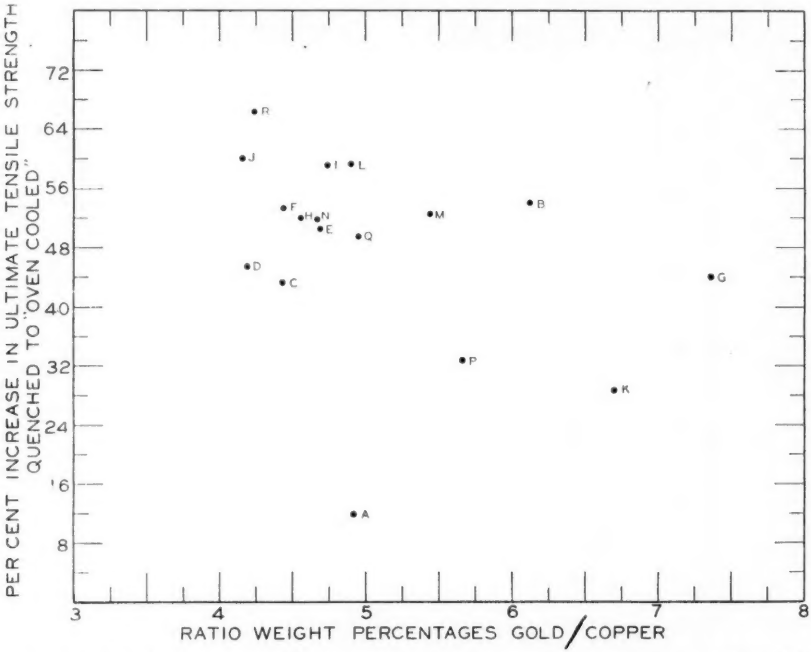


Fig. 16.—Relation between gold: copper ratio and increase in strength for wrought gold alloys.

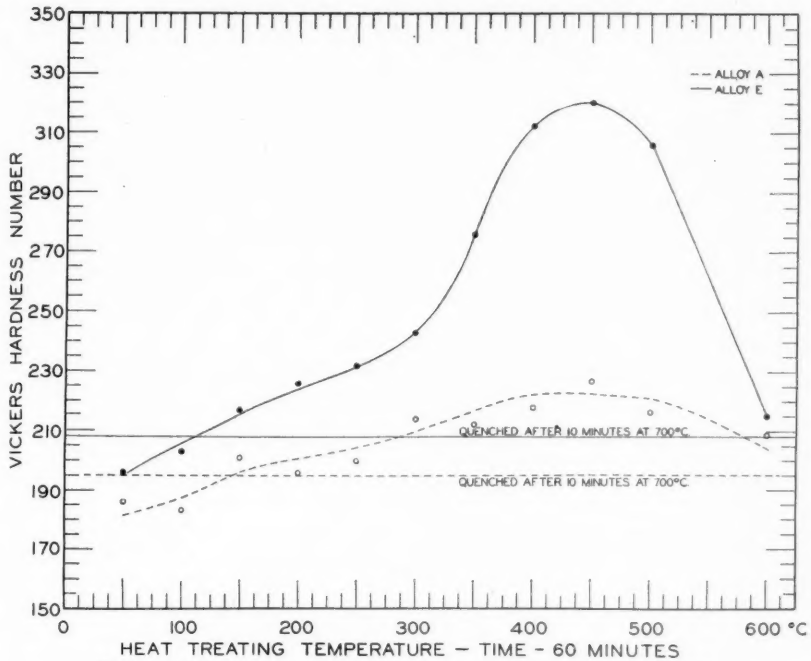


Fig. 17.—Effect of heat treatment on hardness of wrought gold alloys.

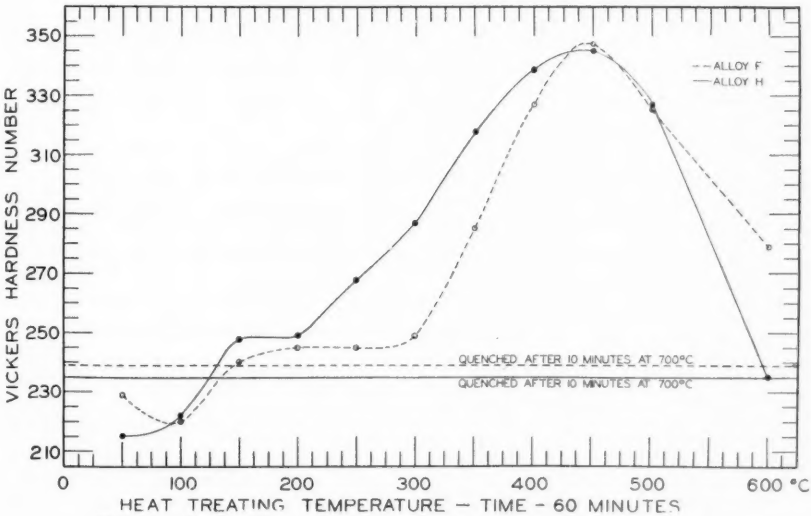


Fig. 18.—Effect of heat treatment on hardness of wrought gold alloys.

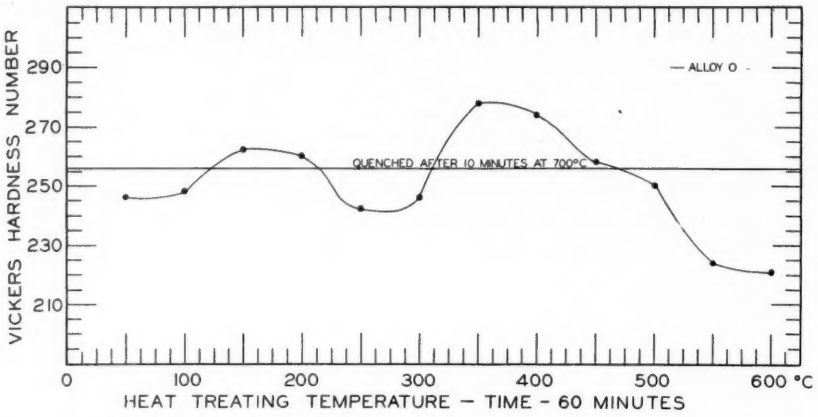


Fig. 19.—Effect of heat treatment on hardness of wrought gold alloys.

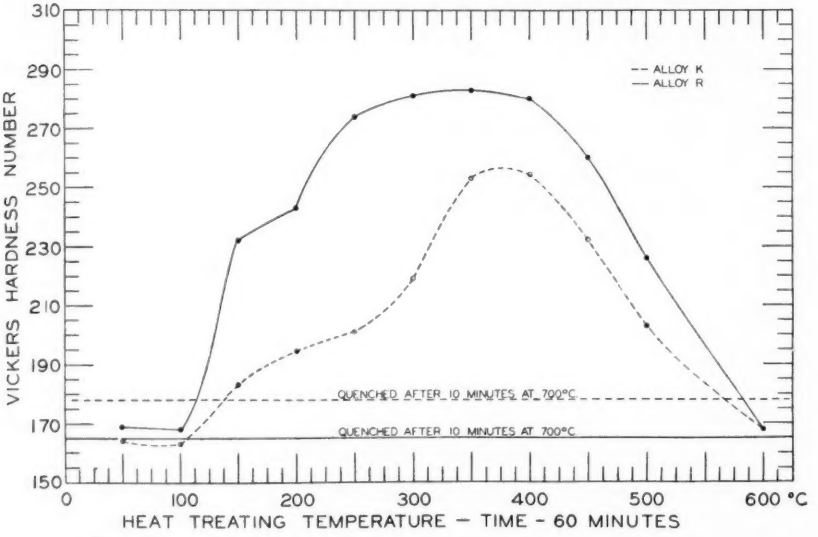


Fig. 20.—Effect of heat treatment on hardness of wrought gold alloys.

ply data on their material after it is heated to a certain definite temperature for such length of time as they think would assure the most satisfactory properties for the purpose at hand.

This would assist the dentist in heat treating and also place the manufacturer's product in a condition for maximum service.

Elongation is particularly affected by "oven-cooling." By selecting an appropriate aging temperature and aging for a definite time, it is possible, in some wires, to hold the tensile strength near

the "oven-cooled" value and at the same time double the elongation, producing a most desirable result. The dentist often speaks of a wire having these properties as being "tough."

The wires were received in many conditions as is shown by the data (Table 2) in the four conditions under which they were tested. Some were quenched, others partially quenched, and therefore had all or part of the work hardening removed. Others appear to have been heat treated to some extent. It would seem best to supply the wire to the user in a soft condition, but we are informed by many concerns that the dentist does not want the wire supplied in the quenched condition.

Claims for excellence of alloys so seldom refer to the properties which we have discussed that many dentists may wonder why these apparently new properties are stressed and others more familiar to them are omitted. For example, data for torsion tests and life value may appear to have been omitted. Data for torsion and life value are similar to, but not so informative, as data on percentage elongation plus data on tensile strength. Hence, we have ignored the less definite tests by torsional and flexure methods. Again, one often hears much about methods for melting by electricity, electrical induction, etc. The method of manufacture of an alloy does not necessarily come within the scope of our work since neither the Bureau of Standards nor the American Dental Association plans to enter the manufacturing field. We were surprised to find the alloys melted by a special induction furnace to be the most erratic of the lot. This must not be regarded as condemning this type of melting furnace, but as showing that the subsequent operations in the fabrication of the materials are reflected in the finished product. The properties which we have reported are, we believe, those properties which are essential to the success of dental work. Only one item has been omitted, namely, the color of the alloy. This, we believe, is a matter for the dentist to decide without recommendation from us.

The average dentist does not have the necessary equipment to "oven-cool" alloys properly; but the testing and research laboratories as well as the manufacturers should have suitable equipment to carry out these treatments and furnish the user with the data.

A simple furnace with a pyrometer attached should be ample for the ordinary heat treatments required by the dentist. The furnace could also be used to burn out molds for casting inlays and dentures and would thus serve in a dual capacity. Further, there is always a desire to use smaller wires in the construction of oral appliances. To demonstrate how this would work practically, let it be assumed that the dentist is using quenched wire 0.040 inch in diameter (18-gage Brown and Sharpe) in the appliance and that the wire will be increased 50 per cent in strength by suitable heat treatment. Then, by heat-treating, one could use a wire 0.036 inch in diameter (19-gage Brown and Sharpe) and still have greater strength in the heat-treated appliance than in the untreated appliance of larger size.

A study of the solders used in the fabrication of gold appliances has not yet been made, but will probably be taken up in the next two years. These solders form an important link in the process and their susceptibility to heat treatment is almost as important as that of the golds.

Objection to practically all values in the specification has been received. The precious metal content (75 per cent)

was criticized as being unnecessarily high. Since all but three of the alloys supplied had 75 per cent or more, and since there are no reliable data to indicate that percentages below 75 would be safe from the standpoint of corrosion in the mouth, the value was not changed.

There were many objections to the "oven-cooling" heat treatment, the chief objection being that it is unnecessarily severe on some serviceable alloys and that only a small percentage of the dentists are using any type of heat treatment. The first criticism was answered in the section on heat treatment. It is probably true that less than 10 per cent of the dentists heat-treat their appliances, but they are neglecting a refinement which has many distinct advantages. The most desirable alloys when properly quenched will be soft and pliable. In this condition, they can be easily worked and adapted, and after the appliance is made, it can then be given an adequate heat treatment, which will restore the "springiness" that the clasp and orthodontia designers desire.

The manufacturers should recommend to the dentists as simple a heat treatment as possible and, when practicable, a definite temperature-time relation should be stated.

Changes in the specification can be made when necessary to include possible future improvements in these alloys.

DENTAL FOCAL INFECTION A POSSIBLE CAUSE OF SYNCOPE: REPORT OF CASE*

By FRANK S. TICHY,† D.D.S., Balboa, Canal Zone

S, lieutenant commander, United States Navy, a naval aviator, came to the dental clinic of the United Naval Air Station, San Diego, Calif., complaining of a peculiar, indistinct feeling of discomfort in the region of the maxillary bone. This feeling was not what could be called a pain, but he felt there was something abnormal in the area mentioned.

On examination, the upper first bicuspid on the left side was found to be impacted. Transillumination and a vitality test of the teeth indicated pulp disease in the upper left cuspid. A further study of this tooth revealed a gangrenous pulp.

During the procedure of establishing drainage through the coronal portion of the cuspid, the patient, who experienced no pain whatsoever, showed signs of a depressive derangement of consciousness, with the usual manifestations of syncope. The head was placed in a lowered position, the clothes were loosened, and aromatic spirits of ammonia was administered by inhalation. The patient remained in a state of unconsciousness for about five minutes.

On return of consciousness, he stated that he experienced the same sensation as he did at the time of the crash of his plane into the bay. The next moment, he again lapsed into an unconscious state, from which he readily recovered.

COMMENT

Since the two affected teeth were infected, there is no doubt that the patient had been absorbing toxic products from them. Further, these toxins, with their depressant effect on the central nervous system and upon the heart action, may have produced an acute anemia of the brain, thus causing sudden loss of consciousness. It does not appear improbable that the impaired physical condition, due to toxic absorption from a dental area, may have been one of the factors in the aviation accident.

*This paper advances the author's private opinion, which is not to be construed as official or as reflecting the views of the Navy Department.

†Lieutenant Commander, Dental Corps, United States Navy.

IMPACTED THIRD AND FOURTH MOLARS

By C. T. MOYLE, D.D.S., Hamilton, Canada

MRS. R., aged 26, complained of neuritis in the right shoulder and arm, also of loss of weight. A lateral view of the left mandible revealed third and fourth molars in "perfect occlusion," completely buried in the ramus and angle of the mandible. Since their removal, the neuritis has disappeared and the patient has gained considerable weight.

Impacted molars in "occlusion."

STUDIES IN LOCAL ANESTHESIA*

By H. C. BENEDICT, Ph.D., STANLEY W. CLARK, LL.B., D.D.S., and CHARLES W. FREEMAN, M.D., D.D.S., F.A.C.D., Chicago, Ill.

Growth of a Research Project on Local Anesthetics†

CERTAIN it is that modern advances in science are the result of definite design or plan and only very infrequently occur by chance. On the other hand, it is seldom that a complete research program is carried out entirely as originally planned. One small part when finished suggests other questions, until the original program has become a tree with many branches. The final results depend on which branch is followed, and may be somewhat removed from the starting point; and yet they will probably be of greater practical value than results as originally anticipated.

The following discussion is an example of the spread of a piece of strictly scientific work into several departments of the dental school, ending in the oral surgery clinic. As this presentation will

*Read before the Chicago Dental Society, March 15, 1932.

*From the Departments of Chemistry, Pharmacology and Oral Surgery, Northwestern University Dental School.

†A contribution from the Chemistry Department of Northwestern University Dental School; by H. C. Benedict.

†A preliminary report of the unpublished portion of this work was made at the Cincinnati meeting of the American Chemical Society, September, 1930.

be an attempt to summarize about three years' work of five or six colleagues who collaborated in this project at some point as the scope expanded, it will be impossible to be anything but brief. A single paragraph may suffice in referring to a year's work and should not be understood as minimizing the effort expended.

Macht and Anderson,[1] in 1927, reported that polarized light decomposed cocain solutions more rapidly than ordinary light of the same intensity, and stated that the solutions were more affected in bottles wrapped in tissue paper than in unwrapped bottles because of light polarization. This suggested that the same might be true of procain and gave rise to some interesting speculations because procain is not optically active, while cocain is. The question as to whether polarized light had a more deleterious effect on procain than has ordinary light was suggested to H. T. Dailey as work suitable for a master's thesis and was undertaken. We[2] subsequently proved that Macht and Anderson were wrong in their conclusions, but that is beside the point. The successful outcome depended on the ability to measure small changes in composition in a solution so dilute that ordinary chemical methods were inadequate. The goldfish method, used by a few other investigators, principally Adams and his co-workers,[3] was adopted and gave interesting results.

The discovery that goldfish were suitable for tests on local anesthetic solutions at once led to a comparative test of several anesthetics available; namely, procain and cocain hydrochlorids, butyn sulphate and procain borate (borocain). Their effectiveness as measured on the goldfish was found to be in the order named,[4] which brought up the question: "Why is the procain borate so much more effective than procain hydrochlorid when they are salts of the same anesthetic base?"

It is obvious that because boric acid is so weak and hydrochloric acid so strong, a solution of the salt of boric acid will be much less acid, or will have a higher p_H. It might be stated that p_H is a function representing the power of the hydrogen ion as distinguished from the total concentration of acid. In fact, there may be no free acid in a certain salt such as procain hydrochlorid, and yet, in solution, hydrogen ions are formed giving an acid "reaction" of greater or less degree. The p_H is a convenient way of expressing this degree. Numerically, a p_H of 7.0 is considered exactly neutral, all larger numbers representing increasing hydroxyl ion concentrations, or loosely, "alkalinity," as the p_H values increase. Conversely, values smaller than 7.0 are for "acid" solutions; the smaller the number, the greater the hydrogen ion concentration. It should be borne in mind that one p_H unit represents a ten-fold change in hydrogen ion concentration as the function is logarithmic.

Tests showed that a procain hydrochlorid solution had a p_H around 5.5, distinctly acid, while the borate had a p_H of 8.4, definitely alkaline. This suggested several points of attack. 1. The p_H of all the solutions was determined. 2. The dissociation constants of the anesthetic bases, on which the p_H of the solution of the salt primarily depends, were determined. 3. The difference in

1. Macht and Anderson: J. Am. Chem. Soc., 49:2017, 1927.

2. Dailey, H. T., and Benedict, H. C.: J. Am. Chem. Soc., 51:808, 1929.

3. Adams, Rideal, Burnett, Jenkens, and Dreger: J. Am. Chem. Soc., 48:1758, 1926.

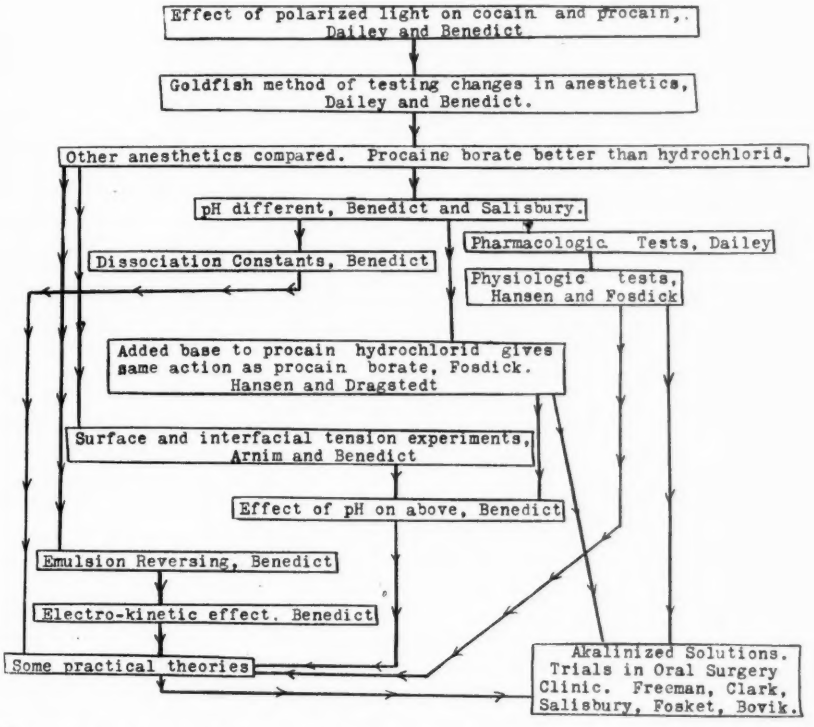
4. Dailey, T. T., and Benedict, F. C.: D. Cosmos, 71:704 (July) 1929.

toxicity of the four anesthetics was worked out by Dailey.[5] 4. The effect on the anesthetic efficiency, as determined on goldfish, of adding base to procain hydrochlorid and acid to procain borate was determined by Fosdick, Hansen and Dragstedt.[6] As a sideline to the immediate investigation, but stimulated by our interest in the procain base, an investigation regarding the fate of procain in the liver was made by Hansen and Fosdick.[7]

Without going into the details of the experiments, I may say that we arrived at the following conclusions, which, as usual, only opened up fresh vistas for research:

1. There is a partial, qualitative relation between the p_H of the solution and the anesthetic efficiency. In general,

OUTLINE OF THE
GROWTH OF A RESEARCH PROJECT ON LOCAL ANESTHETICS


Effect of polarized light on cocain and procain, Dailey and Benedict
Goldfish method of testing changes in anesthetics, Dailey and Benedict.
Other anesthetics compared. Procaine borate better than hydrochlorid.
pH different, Benedict and Salisbury.
Dissociation Constants, Benedict
Pharmacologic Tests, Dailey
Physiologic tests, Hansen and Fosdick
Added base to procain hydrochlorid gives same action as procain borate, Fosdick. Hansen and Dragstedt
Surface and interfacial tension experiments, Arnim and Benedict
Effect of pH on above, Benedict
Emulsion Reversing, Benedict
Electro-kinetic effect. Benedict
Some practical theories
Akalinized Solutions. Trials in Oral Surgery Clinic. Freeman, Clark, Salisbury, Fosket, Bovik.

5. Dailey, H. T.: D. Cosmos, 71:945 (Oct.) 1929.

6. Fosdick, L. S.; Hansen, H. L., and Dragstedt, C. A.: Proc. Soc. Exp. Biol. & Med., 27:529 (March) 1930.

7. Fosdick, L. S., and Hansen, H. L.: D. Cosmos, 73:1082 (Nov.) 1931.

the more alkaline the solution, the greater the effectiveness.

2. The same can be said of the dissociation constant, although no quantitative relation was found.

3. The molecular toxicity of procain hydrochlorid and borate is the same; which indicates that the toxicity depends only on the procain base content of the salt and has nothing to do with the acid with which the base is combined.

4. With the same molecular concentrations of procain hydrochlorid and borate, the effect on goldfish is identical when enough base is added to the solution of the hydrochlorid to make the p_H the same as the borate. The reverse of this is also true: when enough acid is added to the borate to yield the same p_H as the hydrochlorid, the anesthetic effect is the same within experimental limits. The boric acid part of the molecule has no effect on the anesthesia, which depends in these solutions entirely on the p_H. But why? Why should the p_H be so important a factor, the borate ion having nothing to do with toxicity or anesthetic efficiency?

We are certainly a long way from polarized light, but not so far as we shall go. While the foregoing work was in progress, a search of the literature was continually being made, and a bibliography of 400 or 500 references was obtained from which a review of the theories of anesthesia was abstracted. Many of the separate theories overlapped and all have been condensed to seven main theories.

1. The precipitation theory. This theory was most clearly defined by Bernard in 1875 and is still being seriously considered. According to this theory, the anesthetic produces a reversible precipitation or coagulation of the substance of the nerve cell. A similar theory, that differs only in that it defines the precipitated material as being lipoidal, states that nerve impulses are stopped by a reversal of the type of lipid emulsion of which the nerves are supposed to consist.

2. The asphyxial theory. Another early theory that has been studied a great deal is that anesthetics in some way hinder oxidation processes from occurring normally in the living cell, particularly the nerve cell, and that anesthesia is due to a reduced function because of this lack of oxygen.

3. The surface tension theory. This theory is frequently referred to as Traube's theory, as he was the first to propose it. Some osmosis experiments of his in 1904 showed that substances which lower the surface tension of water pass most rapidly into the cell, and he drew the conclusion that the surface tension and narcotic power of anesthetics are related. As expanded by Traube and other investigators, this theory overlaps the adsorption and the permeability theories and really is not a theory for the mechanism of the production of anesthesia.[8]

4. The lipoid solubility theory. This is usually referred to as the Meyer-Overton theory, as it was simultaneously and independently proposed by these investigators in 1901. Essentially, the theory states that anesthetics are lipid soluble and that the effectiveness of the anesthetic depends on its distribution between oil and water, the one most soluble in oil being the best anesthetic. Conclusions regarding some very early work which led up to this theory are sometimes expressed as a separate theory, i.e., that anesthetics actually dissolve some lipid in the nerve cells.

5. The adsorption theory. This theory is largely that of Warburg, by whom it has been reduced to mathemat-

8. Benedict, H. C.: D. Cosmos, 71:861 (Sept.) 1929.

ical form for models, but these formulas do not seem to apply to the central nervous system. As the name indicates the theory states that an anesthetic is selectively adsorbed on nervous tissue. This theory and most of the work on it seem to us to belong more properly under the surface tension theory, or vice versa, and the further explanation of what the anesthetic does when it is adsorbed may be subdivided between the asphyxial, the permeability or any other theory. It is widely quoted as a distinct theory.

6. The permeability theory. This theory, which states that the anesthetic causes a decreased permeability of the cell, is usually attributed to Lillie (1909). A similar theory is sometimes classified as a dehydration theory, in which it has been claimed by several workers that the cause of anesthesia is a loss of water from the cell.

7. The electrical theory. A theory more in keeping with the electrical method of stimulation usually used on nerves in the laboratory is that the anesthetic causes some change (usually a decrease) in the potential difference between the cell and its environment. The main exponent of this theory is Beutner.

It will be noted that two distinct features, which are confounded in these theories, are here clearly differentiated; namely, the mechanism of anesthesia, or how anesthesia is brought about, and the efficiency of the anesthetic. These conceptions gave us two points of attack on anesthetics, and the theories suggest several other experiments.

As the surface tension of an anesthetic solution determines the relative amount of anesthetic adsorbed in the interface, and, as we thought, would give a clue as to the efficiency, about 800 surface tension measurements were made on the four anesthetics under consideration by Arnim.[9] These showed a qualitative relationship to the efficiency, but the relation was far from perfect. Later, the effect of the p_H on the surface tension of procain solutions was determined, and, by comparing this with the effect of the p_H on anesthetic efficiency, we could show that the surface tension was an important factor, but was not the sole determining factor in the problem. Similar work was done on the interfacial tension and a better correlation was obtained. About 3,000 tension tests were made in all.

As a combination of the electrical and phase inversion theories of anesthesia seemed most plausible and promising, experiments were continued, demonstrating that components with anesthetic properties would invert an emulsion of oil in

TABLE I.—QUALITATIVE PROPERTY RELATIONSHIPS*

Anesthetics in Order of Increasing Efficiency	S. T.	I. T	Electro-Kinetic Effect	D. C.	p_H
1. Procain hydrochlorid.....	1	1	2	2	2
2. Cocain hydrochlorid.....	2	2	3	1	1
3. Butyn sulphate.	4	3	4	3	3
4. Procain borate.....	3	4	?	2	4

*S. T., surface tension; I. T., interfacial tension; D. C., dissociation constant. These figures are not the actually determined quantities, but represent the relations between the orders of magnitude of each property as these would alter the anesthetic efficiency.

9. Benedict, H. C.; Dailey, H. T., and Arnim, S. S.: D. Cosmos, 71:866 (Sept.) 1929.

water, of which the nerve is supposed to consist. It was also shown that nonanesthetic substances did not produce this change. An explanation for this was sought in the electrokinetic effects at an interface. By electrophoresis experiments, it was found that the charge reducing power of an anesthetic is roughly equivalent to the anesthetic power.

While all of this work raises more questions than it answers, it has been possible to draw some tentative conclusions of theoretical and practical importance. From the qualitative relation table, it will be seen that no one physical property can be considered as of prime importance and yet, when all are reviewed together, a distinct trend is noticed. Procain hydrochlorid, which is the least effective anesthetic of those studied, also stands first in each of the physical properties, and, as the effectiveness increases, the physical properties change in the same general manner.

An effective local anesthetic will have a large dissociation constant and, possibly because of combination with a weak acid, the solution should have a relatively high p_H. The interfacial tension of its solution against pure petroleum oil will be low. It will be effective in reducing the charge on an oil droplet.

An anesthetic is effective because a low interfacial tension increases the useful concentration of anesthetic on the nerve.[8] If increasing the p_H decreases the interfacial tension, the effectiveness is also increased. Increasing the p_H also increases the effective concentration within the cell, according to the principle of Donnan's theory of membrane equilibrium.

The mechanism of anesthesia is probably the reversible precipitation or coagulation of colloids, probably lipids, and this is brought about largely by discharging the charge on the particles which has been keeping them apart.

To solutions of procain hydrochlorid were added various amounts of sodium carbonate to yield solutions which were from ten to fifteen times as effective on goldfish as the original solutions. These solutions were all slightly alkaline, having a p_H of from 7.3 to 8.3. After chemical, physicochemical, physiologic and pharmacologic tests, these alkalinized solutions were tried in the oral surgery clinic, a fitting climax.

Preliminary reports of the clinical results have been made by Freeman[10] and Freeman and Benedict[11] and a more comprehensive report follows.

Pharmacologic Aspects of Local Anesthetics†

For many years, it has been apparent to clinicians and laboratory workers interested in the development of local anesthesia that sometime an anesthetic solution should be developed wherein the toxic elements and irritating properties of procain hydrochlorid would be reduced or, if possible, eliminated. For a quarter of a century, since Einhorn introduced novocain hydrochlorid (1905), the same solution in various strengths of 0.5 to 2 per cent plus the required epinephrin content has been routinely employed. While it may be rationally maintained by many that a solution like this, having been used over so long a time with such apparent success, is a fairly satisfactory vehicle, to careful clinical observers and laboratory workers there is now, and always has been, much room for improvement.

Though many substitutes of some merit have been offered by different in-

10. Freeman, C. W.: D. Cosmos, 71:949 (Oct.) 1929.

11. Freeman, C. W., and Benedict, H. C.: Chicago D. Soc. Bull., 10:3 (Aug. 8) 1930.

†By Stanley W. Clark, L.L.B., D.D.S.

vestigators from time to time, purporting to improve on the efficiency of these solutions, until very recent times there has been little coordinated research on the problem.

The discovery of novocain hydrochlorid represented a tremendous advance over the use of extremely poisonous cocain hydrochlorid, introduced by Koller in 1884. Whether the developments during the last few years will eventually represent the next great step in the evolution of local anesthesia remains to be proved. The problem in its present stage of development would seem to support this position.

In an article published in Germany, Guido Fisher (1928)[1] reveals that studies with alkaline solutions in local anesthesia have been proceeding along the same general lines as has the work at Northwestern University. The basis of his theme is the favorable clinical results obtained by the use of alkaline local anesthetic solutions. The marked lack of irritation to the tissues and the increased speed of anesthesia are especially stressed. He advises that use of the chemically pure, freshly prepared solutions will prevent much of the pain experienced during injection as well as the edema and after-pain.

Discussing epinephrin, he holds that its toxicity is increased by the procain in solution, but that the fresh preparation of the solution reduces this possibility in a marked degree.

Reference is made to the work of Gaza and Brandi (1926-1927),[13] who found that inflammation was associated with a local acidosis of the inflamed tissues, and the degree of acidity depended on the acuteness of the inflammatory reaction. They showed that injecting acid solutions in such inflamed regions caused pain, while alkaline solutions with a p_H of 8.0 could be injected without pain. It was thought that, in these cases of local inflammation the pain was caused by the acidosis of the part. Their treatment of the inflammation consisted of injecting alkaline solutions into the infected regions, irrigating the field with the alkaline solutions and applying wet dressings of the same solution.

The solution used consisted of:

Secondary sodium phosphate (Na_2HPO_4)	6.49 gm.
Sodium chlorate ($NaClO_3$)	6.44 gm.
Distilled water	1,000 c.c.

$p_H = 9.1$

Fisher applied this high p_H solution, to which no anesthetic agent had been added, in painful mouth infections, with marked beneficial results. He stresses the necessity of always using freshly prepared solutions. Gaza and Brandi[13] found that pain accompanied the injection of solutions below a p_H of 7.2; that pain increased with the lowering of the p_H, and that solutions having a p_H 8.0 or above were absolutely painless. These principles were applied to local anesthetic solutions by Fisher, who states that the time and depth of anesthesia were considerably improved, and there was no after-pain. He affirms that anesthesia takes place immediately after the injection; whereas, with acid solutions, the acidity first has to be neutralized by the tissues before anesthesia can be established. He objects to the stock alkaline solution dispensed in ampuls as usually containing acid and carbon dioxid.

The manner of distribution to dentists in Germany has been solved by the use of a double ampul (Max Woelur), wherein the procain, epinephrin, sodium phosphate and sodium chlorate are kept

12. Fischer, Guido: Klin. Wchnschr., 2: 1838, No. 7, 1928.

13. Von Gaza and Brandi: Klin. Wchnschr., No. 25, 1926; No. 1, 1927.

separate in dry form in one ampul and the distilled water in another.

THE HYDROCHLORID AND BORATE OF PROCAIN

The term "procain" is the American designation of "novocain." Prior to the World War, this agent was imported solely from Germany; a situation which later made it difficult or next to impossible for us to obtain the product. In 1917, the United States Government issued licenses to several chemical manufacturers in this country to manufacture novocain, with the provision that the drug should be known by its American name, "procain." Since the Federal Trade Commission took this action, the name of the drug has officially become "procain." (Nevin and Puterbaugh.[14])

In our writings, therefore, this agent is consistently referred to by its proper name: namely, procain hydrochlorid.

Procain hydrochlorid is the hydrochloric acid salt of procain base, and procain borate is the boric acid salt of procain base. They differ only in the acid used to change the insoluble alkaloidal base into the soluble alkaloidal salt. Procain hydrochlorid (without epinephrin), in aqueous solution, is acid in reaction, with a p_H of about 5.5; while procain borate, in aqueous solution, is alkaline in reaction, with a p_H of about 8.4. This wide variation in p_H accounts for the great difference in the efficiency of the two salts.

EPINEPHRIN

Epinephrin is the active principle of the medulla of the suprarenal glands, first isolated by Abel (1897) and by Takamine (1901), who patented it as "adrenalin." It is manufactured synthetically, the racemic compound having been made by Stolz (1906). Flacher (1908) separated the racemic hormone into its optical isomers, and, since that time, the synthetic levorotatory hormone has been available to medicine.

Abel gave it the name "epinephrin." The United States Pharmacopeia has adopted this name, thus making epinephrin the official designation. Other names by which it is known are suprarenin, adrenalin and adrenin.

The blood pressure is raised by the action of the epinephrin on the sympathetic nerves of the blood vessels, the latter being constricted and the pressure thus raised. Epinephrin is the most powerful vasoconstrictor known.

The vasoconstriction is accompanied by cardiac acceleration, and this action furnishes the explanation for the increase in heart rate immediately following the injection of a local anesthetic containing epinephrin.

Epinephrin is used in local anesthetic solutions for two reasons: (1) to constrict the blood vessels in the field of operation and thus reduce bleeding, and (2) to so retard absorption of the anesthetic solution as to confine it to the site desired.

The form in which it is generally known to the profession is "adrenalin," a 1:1,000 physiologic sodium chlorid solution of the hydrochlorid of the active principle of the suprarenal glands of animals, some hydrochloric acid having been added to this solution. Epinephrin is quickly destroyed in solution by the presence of fixed alkalis, but solutions of the strength of 1:1,000 (the usual stock strength of adrenalin) may be preserved

14. Nevin, Mendel, and Puterbaugh, P. G.: Conduction, Infiltration and General Anesthesia in Dentistry, Ed. 2, Brooklyn: Dental Items of Interest Publishing Co., 1924, p. 244.

a long time in the presence of dilute acids. (Solis-Cohen.[15])

U. S. P. X. Solution of Epinephrin Hydrochlorid (Synonym, Solution of Adrenalin Hydrochlorid)

Adrenalin	1 gm.
Chloroform	5 c.c.
Sodium chlorid	9 gm.
Dilute hydrochloric acid	3 c.c.
Distilled water recently boiled and cooled q. s. ad.	1,000 c.c.

When the local anesthetic solution is made from procain hydrochlorid crystals or from tablets not containing epinephrin, the latter may be added by introducing 1 minim (approximately one drop) of adrenalin to each 2 c.c. of solution. This makes a strength of epinephrin about 1:30,000, the usual concentration employed. At the rate of 1 minim to 2 c.c. of solution, it is obvious that ordinary operations requiring from 4 to 6 c.c. of anesthetic solution include the injection of from 2 to 4 minims of adrenalin.

The ordinary dose, intravenously or intramuscularly, is from 5 to 15 minims. Thus, it is readily observed that dental injections usually are considerably lower in adrenalin than an average dose given in cardiac embarrassment, low blood pressure or bronchial asthma. Nevertheless, there is frequently considerable reaction by the patient following dental injection of local anesthetic solutions. The reaction is almost immediate because of (1) the rapidity of absorption of the adrenalin (the circulatory cycle is from twenty-five to thirty seconds), followed by the rise in blood pressure and acceleration of the heart action, and (2) the unusual sensitiveness of many people to small doses of adrenalin.

Because of these physiologic effects the dosage of epinephrin should always be kept at a minimum. Another very important reason that the dosage should be curtailed is that the epinephrin is combined with hydrochloric acid as epinephrin hydrochlorid, the p_H of which is about 3.3. This, of course, will lower the p_H of the anesthetic solution, an action which is obviously unfavorable. Supplementing the observations on adrenalin dosage, it would be well to keep in mind that most of the temporary unfavorable manifestations of patients following local anesthetic injections are actually due more to psychic influences than to the physiologic effect of the adrenalin.

Lastly, it should be repeatedly stressed that the amount of epinephrin or adrenalin used in these alkaline local anesthetic solutions is the same as has always been used in the previously employed acid solutions.

Dr. Freeman will develop the fact that clinical observation of alkaline local anesthetic solutions reveals them to be much less toxic. As the epinephrin dosage in either acid or alkaline solution is approximately the same, the conclusion one is forced to draw is that the character of the alkaline solution is responsible for the lessened toxicity.

There is adequate reason for the belief that further improvement in the efficiency of local anesthetic solutions will include the development of a new vasoconstrictor agent which will present all the advantages and fewer of the disadvantages of epinephrin. We have given some thought to this problem and have done a little investigating with certain products available on the market, but results up to the present have not proved satisfactory.

15. Solis-Cohen, Solomon, and Githens, T. S.: Pharmacotherapeutics, Materia Medica and Drug Action, New York: D. Appleton & Company, 1928, p. 1460.

BUFFERED PROCAIN SOLUTIONS AND ALKALINE PROCAIN SOLUTIONS

"Buffer," in general, is a term applied to the potential alkalinity of the blood, which acts as an intermediary between a tendency to acidosis and the normal alkalinity. (Stedman.)

Buffer salts are certain substances, such as mono-acid and diacid sodium phosphates and sodium bicarbonate contained in the blood, which tend to fix any slight excess of acid or alkali, acting therefore as a "tampon" to absorb the excess of such acid or alkali. It may be conceived to act as a "buffer" to ease the shock which such excess would otherwise cause. (Stedman.)

The buffer value of the blood may be said to be the ability of the blood to care for acid-alkali fluctuations without disturbance of the hydrogen-ion concentration. (Stedman.)

From these definitions, it will be observed that a buffer is an agent whose presence in the blood or in a solution tends to hold constant the hydrogen-ion concentration in spite of the addition of acid or alkali. All this means that the degree of hydrogen-ion concentration, while fluctuating some, is maintained with a minimal degree of change.

To apply these principles to local anesthetic solutions, it may be said that the addition of an alkaline salt such as sodium carbonate is done not so much for the purpose of making a highly buffered solution as for the purpose of increasing the alkalinity of the whole.

It is true that the desired combination of procain hydrochlorid, epinephrin hydrochlorid and sodium carbonate in such concentrations does produce a very slightly buffered solution; but, more importantly, it raises the alkalinity to a p_H value of about 7.8. The buffering action slightly protects this alkalinity, or hydrogen-ion concentration, thus resisting chemical change during clinical application.

Mono-acid and diacid sodium phosphate have been commonly employed by others in this type of solution to resist change in the hydrogen-ion concentration. Such solutions are quite highly buffered, and have been objected to on the basis that the blood will be unable to bring them to its own p_H value. We feel that this objection cannot be raised against our solutions in view of the fact that their buffering power is extremely small. We have obtained very satisfactory results with sodium carbonate.

Drs. Freeman and Benedict[11] have reported results of the use of sodium carbonate, as well as potassium carbonate, in local anesthetic solutions. Our efforts with the potassium salt have been satisfactory. Potassium carbonate is somewhat hygroscopic (absorbs and retains moisture), while sodium carbonate is not. The latter, therefore, is more easily weighed out than the former. Another objection to potassium carbonate is that if it is combined in a tablet with procain and epinephrin, the moisture-absorbing quality of the potassium salt might seriously affect the preservation of the epinephrin.

While much work is yet to be done on buffered solutions, the developments up to the present time seem to indicate that nothing more complicated than the simplest alkaline salts is necessary to prepare these local anesthetic solutions with a p_H value comparable to or just above that of the blood.

Theoretically, it would appear that when appropriate salts are added to a solution wherein its p_H value is maintained at or slightly above the p_H value of the blood (7.4) and body fluids, that solution should be satisfactory as a local anesthetic vehicle. The addition of a buffer salt which establishes a p_H value not

nearly equal to that of the blood would be unsatisfactory, as such a solution must first be rendered compatible by the blood and body fluids. Where the hydrogen-ion concentration had previously been fixed at a point too high or too low as compared with that of the blood, the solution itself would conceivably resist change by the blood and much lessened efficiency, or possibility an irritation, result therefrom.

It has been long established that the blood and body fluids are highly buffered and that this condition renders them capable of resisting change of p_H, even when acids or alkalis are introduced. The injection of an anesthetic solution with a reasonable variation from the p_H of the blood is not likely to produce a marked tissue disturbance. Clinical observation supports the evidence that solutions having extreme variations have been used, and the postinjection sequelae have not, as a rule, been unfavorable. How far this variation above or below the p_H of the blood may exist and still produce satisfactory results has not yet been established, but there seems to be some reason, at the present time, for the belief that extreme variations on either the alkaline or the acid side, and particularly on the acid side, are undesirable, and that the more closely the solutions approximate the p_H of the blood, the less probability there will be of local tissue disturbance. The variation that we have allowed in this work has been on the alkaline side. The solutions employed in our clinics at the present time have a p_H value of about 8.0.

LOCAL REACTION OF ALKALINE SOLUTIONS ON TISSUES

Gaza and Brandi,[13] as reported, found that areas of inflamed and purulent tissue were manifestly benefited by the injection locally of an alkaline solution without procain, and that hastened healing resulted. Fisher,[12] when using the alkaline local anesthetic solution in the mouth, noted that the postinjection period was characterized by marked absence of pain. Other investigators report comparable observations.

The postinjection conditions observed in our work do not vary measurably from the findings of these men. While the manner of making the injection and the character and extent of the operation should not be lost sight of in its relation to the etiology of postoperative pain, when the alkaline solutions are properly employed, such unfavorable clinical manifestations are much less frequently encountered. Uneventful and rapid healing with an absence of after-pain is the postoperative aspect which generally prevails. Local edema, tissue necrosis, delayed healing, sloughing and pain are conditions which, in some degree, not infrequently serve to complicate the clinical picture of cases where the irritating acid stock solutions, and also the fresh solutions with a lower p_H, were employed. These results have been largely overcome by the introduction of the high p_H anesthetics. There certainly is a difference clinically, and this difference is readily observable to anyone working in the field.

CLINICAL APPLICATION OF NEWER INFORMATION ON LOCAL ANESTHESIA†

The practical value of local anesthesia in routine dental practice is too well established to require proof. It is employed in practically every dental office as an approved method of procedure which permits the operator to minimize the discomfort of the patient and at the same time perform the operation with greater

†By Charles W. Freeman, M.S., D.D.S., F.A.C.D.

accuracy and consequently more satisfaction.

The technic of inducing anesthesia is fairly well standardized and the profession is quite generally competent to employ it with efficient results. The few dentists who are not equipped by training to make the injections which have been found to give adequate anesthesia are working under a distinct handicap in the practice of dentistry, and they should amplify their skill to the point where they may obtain the greatest advantage from this very useful method of minimizing pain and increasing the satisfaction of serving their patients.

Although procain hydrochlorid has been the agent of choice for dental local anesthesia for nearly twenty-five years, and has proved its value in innumerable cases, there is no reason to accept it as the ultimate perfect agent, and there is no reason to believe that improved materials will not be developed.

The studies which have been progressing for the past five years at Northwestern University Dental School have had for their principal motive the acquisition of additional scientific data concerning local anesthetics, but the practical application to dental practice has been kept constantly in mind as the ultimate goal of these studies. Since this discussion concerns only the practical clinical application of newer information on local anesthetics, statements will be confined to those facts which may be immediately applied in the practice of dentistry.

It is pertinent to state that for the past four years the greater portion of the local anesthetic injections in the oral surgery department at Northwestern University Dental School have been made with solutions which were under investigation. A total of more than 30,000 such injections have been made in an effort to give thorough clinical tests to every phase of these studies as they progressed. This rather extensive clinical investigation has, in our opinion, afforded adequate justification for the statements on clinical efficiency, since the severe test of clinical application is the best criterion of usefulness.

In order to clarify the subjects to be discussed, a statement will be made of four facts which appear to be thoroughly proved, and which have practical importance in the use of local anesthetics.

1. Procain hydrochlorid, which is normally acid in solution, may be made more rapidly effective and more satisfactory for local anesthesia by the addition of sufficient alkali to raise the p_H to approximately that of the blood.

2. Procain borate, which is normally alkaline in solution, is a safe, effective and satisfactory local anesthetic, having some definite advantages over procain hydrochlorid.

3. Any local anesthetic of the procain type which is alkaline in solution is unstable when combined with epinephrin, and cannot be satisfactorily prepared and kept in stock solution.

4. Routine methods of procedure may be developed in the dental office whereby the preparation of a fresh local anesthetic solution is not laborious and requires no more time than the use of stock solutions.

ALKALINE SOLUTIONS OF PROCAIN HYDROCHLORID

Clinical investigations with alkaline procain hydrochorid solutions have amply supported laboratory experiments in demonstrating their effectiveness for local anesthesia. Such alkaline solutions have been found to be consistently more rapid in action, the anesthesia induced is equally profound, the local tissue disturbance is much less and the immediate general systemic disturbances occur less

frequently than with acid solutions.

Whether this increased efficiency is due entirely to the change in p_H we cannot say, and what other factors may enter into the complicated physiochemical reactions resulting in more rapid induction of the anesthesia cannot at present be fully answered. We can say with considerable assurance that raising the p_H of a solution of procain hydrochlorid by the addition of alkali does have a marked effect on the clinical results obtained; the time required in the induction of anesthesia apparently being definitely related to the p_H of the solution.

The induction time in mandibular injections with procain hydrochlorid with a p_H of 5.5 is generally accepted as being from ten to fifteen minutes, although more rapid results do frequently occur. The addition of sufficient alkali to adjust the p_H of the solution to equal that of the blood, which is 7.4, may be expected to result in an average induction time of about four minutes, and the addition of further alkali to raise the p_H to 8.0 or above will frequently result in complete mandibular anesthesia in two minutes or less. On several occasions, complete mandibular anesthesia has been induced in thirty seconds from the time the injection was begun.

A prominent oral surgeon told me that for years he has used sterile tap water in preference to distilled water for making local anesthetic solutions, and that his results were more satisfactory. His very satisfactory results and almost complete absence of postinjection pain were attributed to a more accurate and delicate technic. Investigation discloses that a procain hydrochlorid and epinephrin solution in Chicago tap water has a p_H of about 6.8, while the same drugs in distilled water have a p_H of 5.4; and this difference in p_H may in part explain the superior results obtained.

In preparing the several test solutions which we have used from time to time in the clinic, several of the more common alkalis have been used, the simplest and one of the most satisfactory being sodium carbonate. At the present time, there is no convenient form of alkali procain hydrochlorid tablets on the market, although it is expected that they will be prepared and marketed, with the alkali, the anesthetic drug and the epinephrin prepared in a single tablet.

It is not particularly difficult to prepare an alkaline vehicle to which may be added the usual procain-epinephrin tablets at the time needed. To make such a simple alkaline local anesthetic solution, 1 gm. of sodium carbonate is added to 1 liter of distilled water, and sterilized in a cotton stoppered flash by boiling. This gives a prepared stable, sterile alkaline vehicle with a sodium carbonate content of 0.1 per cent. Suitable amounts of the vehicle are poured out for the individual patient and tablets of procain-epinephrin are added to make a 2 per cent solution. The resulting anesthetic solution has a p_H of about 7.8, being slightly more alkaline than the blood, and produces rapid anesthesia with practically no postinjection disturbances.

A slightly more rapid anesthetic action can be produced by increasing the alkali content above this point; but when the p_H is raised much above 8.0, the solutions are not stable enough to be considered from the clinical point of view. The increase of the alkali to bring the p_H materially higher than that of the blood is not considered desirable, although a solution which is within the p_H range of from 6.4 to 8.4 may probably be considered to be within satisfactory limits.

Many thousands of injections have been made with sodium carbonate solutions of procain hydrochlorid and epi-

nephrin with a p_H between 7.4 and 8.0 and the clinical results have been most satisfactory. The anesthetic results naturally are dependent on more than the p_H of the solution, the amount of epinephrin in the solution having a distinct bearing on the results, and the variation in technic of injection, particularly the inaccuracies which may be expected among students in a clinic, being an important cause for the variable results obtained.

For many years, it has been our policy to reduce the amount of epinephrin in local anesthetics to the minimum consistent with satisfactory results, and we have assured ourselves that an increase in epinephrin content to equal the amount frequently used in stock solutions would give more striking results in induction time, and also give an anesthesia with longer duration.

The duration time of anesthesia with alkaline procain hydrochlorid solutions has been taken in many cases, and while there are no reliable data available on the duration of anesthesia with acid solutions, it may safely be stated that an injection with an alkali solution does not give so long continued anesthesia as injection with acid solutions. The duration time is estimated at about three-fourths that obtained with the acid solutions, but there are few occasions when it is not ample for the task. Operations have been carried out which continued for one and a quarter hours from one mandibular injection, and in others the patient has proved to be insufficiently anesthetized at the end of twenty-five minutes.

Aside from the fact that the duration of anesthesia is shorter, only one disadvantage of alkaline solutions has been observed, the lack of stability of the solution, especially when epinephrin is added; which renders it necessary to make the solution fresh for each patient. This is not an unmixed evil, since, as has consistently been our opinion, a freshly prepared solution is distinctly preferable to any stock preparation.

An alkali solution of procain hydrochlorid, or any local anesthetic solution of this procain group with a p_H above 7.0, begins oxidizing within an hour of preparation, and probably should not be used if more than 1 hour old. From the present evidence, it appears improbable that an alkaline solution can be successfully prepared and marketed as a stock solution in any sort of container.

PROCAIN BORATE

Procain borate has been investigated quite thoroughly and has undergone sufficient clinical experimentation to justify the statement that it is a safe and satisfactory material for employment in local anesthesia. It differs from procain hydrochlorid in that it is a different salt of the same base, and since it is alkaline in reaction, while the hydrochlorid of procain is acid, there is no need to add an alkali to obtain the advantages inherent in alkaline solutions. As far as clinical and experimental evidence is concerned, the effectiveness of procain borate is directly comparable to that of procain hydrochlorid which has been brought to the same p_H, about 8.3. Chemically, procain borate contains less of the base than does a similar weight of procain hydrochlorid; which accounts for the decreased toxicity as found by Dailey in the injection of mice.

In solution with epinephrin as used in local anesthesia, the p_H of procain borate is slightly over 8.0, and is very rapidly effective, giving complete anesthesia in mandibular injections in as short a time as one or two minutes in many cases. It is no more stable in solution than a highly alkalinized procain hydrochlorid, but

when made up in tablets with epinephrin, no oxidation or deterioration has been observed. This undoubtedly might occur if the tablets were exposed to moisture, as that difficulty has been a constant one in the marketing of procain hydrochlorid tablets even without the alkali.

Procain borate has been the standard local anesthetic agent in my office for several years, and the results have been most satisfactory. The fact that the solution is alkaline has, in my opinion, accounted for the slight amount of postinjection disturbances, many patients calling attention to the fact that, in previous injections, there had been much pain immediately following the return of sensation. While there are other facts which may account for such pain, and I am not ready to state that all postinjection discomfort has been eliminated in my office by the use of solutions with a high p_H, there is sufficient evidence to state that the use of solutions with a p_H which does not approximate that of the blood is an important cause of postinjection pain and tissue disturbance.

The general systemic reactions immediately following the injection of procain borate have been distinctly less than those previously encountered with acid solution; and the same is true of alkaline procain hydrochlorid. Whether this is due to the nearer approach of the solution to the p_H of the blood or to some other fact cannot be stated. It is a clinical observation which is sufficiently outstanding to be noted and commented on by many practitioners who have adopted this material.

NUPERCAIN

Nupercain is an agent for local anesthesia which has been quite recently introduced and which has received preliminary investigation in our studies. Our principal interest in nupercain is based on the expectation that it will not cause a dermatitis on the hands of the dentist, and since there are many practitioners who are seriously affected by the procain salts, it may prove to have a distinct value in the field of dentistry.

Nupercain was discovered by Mieschcr in 1928 and has received several favorable reports in the medical literature, especially in Europe. Only two reports were discovered dealing with the use of this agent in dental anesthesia, but since the Council on Pharmacy and Chemistry of the American Medical Association has made a favorable report, it was considered of sufficient importance to investigate.

Nupercain is admittedly much more toxic than most local anesthetics, having a toxicity about twenty times as great as procain hydrochlorid, but it is effective in such weak solutions that it is apparently safe for dental operations. It is slightly alkaline in reaction, but the free base is so readily precipitated that the manufacturers recommend reducing the p_H to about 6.5. The advantage claimed for nupercain is the longer duration of the anesthesia.

Deyton and Wi'son made more than 300 injections in our clinic after thorough laboratory investigation under the direction of E. A. Zaus. The average duration in mandibular anesthesia was over seven hours, and, in infiltration anesthesia, about three hours. The induction time was less than with acid procain, averaging six and one-half minutes in mandibular injections. The most satisfactory concentration was a 1:500 solution slightly acidified, and with the usual amount of epinephrin.

Postinjection disturbances were less than with acid procain; in fact, there were practically no postinjection disturbances. This may be accounted for by the

fact that the solution has a high p_H value or possibly because of the small amount of drug in the solution, since the use of 0.2 per cent solution would introduce very small amounts of anesthetic material.

The difficulties of use are in the small amounts employed and the consequent difficulty of accurate preparation of solutions.

PANTHESIN

Panthesin is now under investigation in our clinic by Dr. Sulzberger, and only the most tentative report can be made at this time. It was first compounded by Prof. Karrer, of Zurich University, in 1921, and belongs to the same general group as procain. It is not injured by boiling, and combines satisfactorily with epinephrin in solution.

Used in a 0.5 per cent solution, in the first series of cases, it resulted in over 90 per cent perfect anesthesia, the induction time being less than with acid procain and the duration considerably longer. Considerable further investigation is necessary before any recommendations can be made in regard to the actual clinical advantages of panthesin.

STOCK SOLUTIONS

The comparative advantages of a freshly prepared solution for local anesthesia as against a manufactured stock solution requires careful consideration. The office preparation requires an exacting technic in the handling of materials, and yet there is no step in such preparation which cannot be safely carried out in a properly equipped dental office. In a discussion of stock solutions, the materials employed must be considered, the methods of preparation and packaging, and the probable stability of such solutions and their integrity after storage and distribution.

The convenience or inconvenience of any method of preparation for the injection of a local anesthetic is an important item in the dental office, where efficient and time-saving methods are always desirable, but the convenience of a method should not receive first consideration. The most important point to consider is the safety and desirability of the materials injected. If the manufacturers can produce a stock solution which is highly satisfactory for use on a patient, and which contains no undesirable materials, one in which the integrity of stability and sterility is unquestioned, and one which is in convenient form for use, the profession would be wise in adopting it. If the requirements for a satisfactory local anesthetic solution can be fulfilled more adequately by the preparation of a fresh solution for the individual patient, the higher type of dentist will prepare his own solution.

Every standard textbook on local anesthesia recommends freshly prepared solutions; and hospitals and surgeons of repute generally do not employ manufactured stock solutions. Since a vasoconstrictor is necessary for satisfactory local anesthesia with the materials now used, and epinephrin, an unstable agent, is the only satisfactory drug available for this purpose, the difficulties are considerable in the manufacture of stock solutions which are stable. A solution which is stable for a time is possible, as has been demonstrated by the manufacturers for several years, but such solutions are made stable only by reducing the p_H by rendering the solution acid, which in our opinion is not desirable. Even with the acid solutions, unless quantities of preservatives are added to the packaged material, a large number of containers are often found to have discolored contents.

Some manufacturers have produced a stock solution with a p_H above 6.0, al-

though it is not proved that the p_H is maintained at this point, but probably lowers after a period of time. If such materials prove reasonably satisfactory, there should be the additional protection of a date stamped on the material, so that it may be discarded after a suitable lapse of time.

The practicability of the addition of chemicals to prevent oxidation has already received considerable study, and a successful chemical solution to this problem of stability may be possible, if it can be proved that the materials used are not injurious when injected, and have no undesirable side reactions; although this will make a more complicated mixture, and simplicity is desirable where possible. A thorough study of this problem is essential, and most careful investigation must be made before such methods of assuring stability are accepted.

It is generally accepted that the problem of sterility of stock solutions in individual containers has been solved satisfactorily, at least when use is made of sealed glass containers. There is evidence that the reputable manufacturers have made considerable progress in controlling the sterility of their products, and that this phase of the preparation is adequately safeguarded, although constant vigilance is necessary to obviate relaxation of the necessary precautions.

From the mechanical point of view, the cartridge and carpul type of syringe has been made to work sufficiently well for practical purposes, although the use of rubber stoppered containers is probably less desirable than sealed glass when unstable drugs are employed. I find that the syringes which are used with container barrels are heavy and awkward and their employment is not conducive to the accurate and delicate technic which can be developed with less cumbersome syringes.

Another objection to the heavy syringes used with the carpul and cartridge type of container is the question of adequate sterilization. Their construction, and that of any syringe which is difficult to assemble, makes the sterilization of the needle inconvenient. I feel satisfied with nothing short of boiling both the syringe and needle, and while I understand that it is possible to boil these syringes with the needle in place, there is considerable delay in waiting for the syringes to cool because of their bulk, and few dentists have cold sterile water available for this purpose. It is practically impossible to use any method of sterilizing the needles between different injections for the same patient except by chemical means, and that method is open to question in hypodermic equipment. The flaming of platinum needles is completely satisfactory, but, in this case, the portion of the needle which penetrates the rubber is not sterilized, and, in general, platinum needles are too soft to be as satisfactory as steel needles for general use.

FRESHLY PREPARED SOLUTIONS

In favor of the freshly prepared solutions we have the assurance that the exact materials desired have been incorporated, with no additional preservatives; that there has been no elapsed time during which the materials may have deteriorated, and that the solution is absolutely fresh for the individual patient. Such a solution may be prepared with the desired p_H to make it compatible with the body tissues and used before oxidation has taken place. In the preparation of such fresh solutions, I have used a method for several years which is inexpensive, convenient and time saving,

and yet permits the preparation of fresh solutions for each patient.

This plan of procedure has been previously described, but I will briefly outline the steps and the advantages in convenience of this method. The all glass Luer type syringes are used for all injections since they can be easily dissembled and boiled, and the slip on needle is most convenient, since it can be so easily removed for reboiling, and in addition, the light weight of this syringe permits a most delicate technic of handling.

The syringes, which are numbered for convenience in assembly, are boiled in quantity and wrapped in sterile gauze, which gives an adequate supply of sterile cool syringes ready for instant use, and obviates the delay of waiting for sterilization and cooling of syringes. The needles are kept boiling in the sterilizer throughout the day and consequently are always ready.

The solution is prepared by placing measured amounts of the vehicle (distilled water, Ringer's solution, an alkaline solution or any preferred vehicle) in small test tubes in a rack specially designed for the purpose. The mouth of the tube is closed with cotton and the entire rack with the measured vehicle in each tube is sterilized in the autoclave. When no autoclave is available, the vehicle can be boiled in the individual tubes, and the cotton plug flamed for sterilization.

In this sterilized vehicle, there is nothing to deteriorate, and it may be kept safely until used, as long as the cotton stoppers are undisturbed. When an injection is to be made, the following procedure is carried out, and accurate time tests have demonstrated that one minute is sufficient for the chair preparation.

The syringe is removed from the cabinet and unrolled from its sterile gauze wrapper. The proper number of tablets are placed on this sterile gauze, the cotton stopper in a test tube is lifted, the tablets are dropped in the vehicle and the stopper is replaced. The solution is then gently warmed over the flame to bring it to body temperature and to assist in dissolving the tablets. When they are completely dissolved, the cotton stopper is again lifted, the syringe without the needle is inserted in the solution and rapidly filled and the cotton stopper is replaced in the tube. The needle is then removed from the sterilizer and placed on the syringe, and the injection is made.

This entire procedure can be carried out very quickly, and all steps are taken care of by the assistant except filling the syringe and placing the needle, which is done by the operator to avoid possible contamination by the second pair of hands. Procain borate tablets dissolve readily even in cold water, but some of the highly compressed procain hydrochlorid tablets require more time in dissolving.

After the injection is made, the needle is removed from the syringe and returned to the sterilizer, and the syringe is again laid on its sterile gauze wrapper; which affords assurance that, if required, another injection can be made with everything in readiness and uncontaminated.

The points of advantage in this plan may not appear important to the operator who has used stock solutions as routine without dissatisfaction, but the preparation of local anesthetic solutions and armamentarium requires the most careful surgical asepsis of all procedures in the dental office, and the desirability of the materials employed for hypodermic injection should be scrutinized more carefully than for any other drugs administered.

As I have frequently stated, I believe that a careless dentist is safer in using a stock solution than in preparing his own. After some further observations of the lack of care in sterilizing methods employed for syringes and needles, I began to doubt the safety of any local anesthetic equipment in the hands of a careless dentist. Fortunately the number of such careless or untrained dentists is fast diminishing, and, in most well managed dental offices, the safety of a local anesthetic injection is carefully guarded.

I am firmly convinced that local anesthetics will be used to a much larger extent in future than they are today, and that any improvement in their use will be accomplished by improving the materials employed, and not by improving the technic of administration. It is therefore desirable that the agents for use in local anesthesia be studied thoroughly, and the cooperation of the chemist and the pharmacologist be enlisted in such studies.

8 South Michigan Avenue.

BENIGN GIANT CELL TUMOR OF THE JAW IN CHILDHOOD: REPORT OF CASE*

By GEORGE A. HECTOR, D.D.S., Livermore, Calif.

THE jaws are frequently the site not only of these neoplasms which are associated with the dental tissues, but also of most of the tumors which are found in other regions of the body. Clinically, the giant-cell tumor is a progressive bone destroying lesion occurring most often between the ages of 16 and 35. Observation shows that the sites of predilection are the ends of the long bones, where the growth period is the longest and the growth momentum is the greatest. The condition seems to be more prevalent in the female.

Giant-cell tumors of the jaws of children in the first decade are relatively uncommon. Geschickter and Copeland[1] noted that, over a period of thirty-five years, the records of the Johns Hopkins Hospital showed only twenty-two cases of giant-cell tumors of the head (exclusive of epulides), of which two were in the temporal fossa, six in the maxilla and fourteen in the mandible. In this group, the youngest patient was a child of 6 years. In the series studied by Kolodny,[2] the jaws were involved in 9 per cent of the cases of giant-cell tumor. In this group, the youngest patient was also 6 years of age. Christensen,[3] in his analysis of 362 cases of giant-cell tumor, found twenty-one in the mandible and twenty-two in the maxilla.

Most authors regard trauma as an etiologic factor in giant-cell tumor. Kolodny, Geschickter and Copeland and others attribute the formation of the

*From the Departments of Dental Medicine and Pathology of the University of Oregon Medical School.

1. Geschickter, C. F.: Arch. Surg., 19: 169-271 (Aug.) 1929.

2. Kolodny, A.: Am. J. Obst. & Gynec., 44:1-214 (April) 1927.

3. Christensen, F. C.: Ann. Surg., 81: 1074-1092 (June) 1925.

tumor in the jaws to the stimulating force of injury following the extraction of teeth and to resorptive processes associated with the loss of the deciduous dentition. A possible embryologic origin was stressed by Kleine[4] in a study of four cases of congenital epulis. Johnson,[5] in a review of the literature on the origin of the giant cell in giant-cell tumors, cited six present-day concepts, in which bone cells, osteoblasts, osteoclasts, decomposing bone, aggregate masses of stroma cells and endothelium of angioblastic

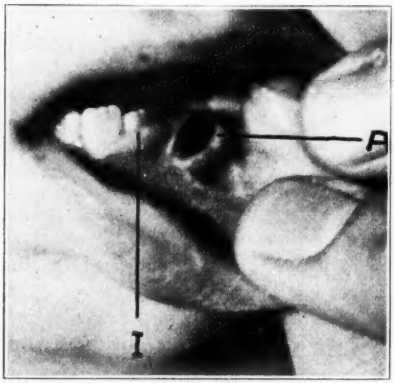


Fig. 1.—Appearance of affected region after tissue was taken for biopsy. There is marked elevation of the edentulous area *(A)*. The growth partially covers the lateral incisor *(I)*.

origin are considered as factors in the production of the multinucleated cell.

As far as we have been able to determine, the occurrence of a giant-cell tumor in the jaw of a 6-year-old child has not been described except in the Geschickter and Copeland and Kolodny series. In view of this fact, it seems justifiable to report the following instance.

REPORT OF CASE

History.—B. L., a girl, aged 6 years, entered the out-patient clinic of the University of Oregon Medical School, April 26, 1932, complaining of a lump on the left side of the lower jaw. The swelling had first been noted a month before and had grown steadily till the time of admittance, causing premature loss of the lower left deciduous cuspid tooth. The mass had never caused any pain or discomfort. The family and personal history were negative.

Physical Examination.—The patient was a well nourished child and apparently not acutely ill. Complete physical examination

Fig. 2.—Roentgenogram of area involved by growth, showing loss of bone over unerupted cuspid and bicuspid teeth.

did not reveal any findings of consequence. There was no evidence of any facial swelling. Intra-oral examination revealed a firm immovable mass with a broad base in the area between the lower left permanent lateral incisor and the left second deciduous molar tooth. The lower left deciduous cuspid was missing and the second deciduous molar was carious, but the caries did not involve the pulp of the tooth. The origin of the growth appeared to be central and the direction of growth was mesially, distally and buccally, with little apparent involvement of the lingual aspect of the alveolar process. There was a marked encroachment on the vestibule, and the adjacent tooth surfaces were partially hidden by the mass. The surface of the tumor was smooth and not tender to palpation. The mucous mem-

4. Kleine, H. O.: Arch. f. Gynäk., 138: 297-317, 1929.

5. Johnson, W. W.: Arch. Path., 10:197-205 (Aug.) 1930.

brane over the growth appeared normal in color but was slightly distended as if from pressure internally. (Fig. 1.)

Additional Clinical Data.—The pulse and temperature were normal. The urinary findings were negative. The blood showed a leukocyte count of 10,200 cells, of which 36 per cent were polymorphonuclear leukocytes and 53 per cent, lymphocytes. The sedimentation rate at fifteen minutes was 10 mm., and at forty-five minutes, 45 mm. The Wassermann and Kahn tests were negative. Intra-oral roentgenograms revealed a loss of bone over the unerupted cuspid and bicuspid teeth. Small spicules of bone were noted in the tissue area directly above the unerupted cuspid tooth. (Fig. 2.) Roentgenograms of the long bones and the skull failed to show any deviation from the normal except in the skull, where there was evidence of moderate intracranial pressure.

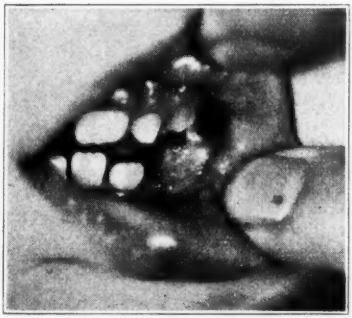


Fig. 3.—Appearance of area after removal of tumor and healing.

In view of the clinical findings, a small V-shaped specimen was taken for biopsy. The mass was firm when cut; and bleeding was slight after the excision. The diagnosis of benign giant-cell tumor (epulis type) was made by Warren C. Hunter of the Department of Pathology.

Operation and Course.—May 4, under regional local anesthesia, the tumor was removed by J. H. Rossman of the staff of the Department of Dental Medicine. An incision was made over the tumor from the deciduous molar to the permanent lateral incisor. The mucous membrane was easily retracted from the underlying mass, which appeared to be lying in the medullary substance of the jaw bone. Close examination revealed the presence of a thin plate of bone covering the buccal aspect of the tumor. There was no apparent invasion of the surrounding soft tissues and the mass was removed in one piece from the pocket in the bone. The tumor was homogeneous and did not show evidence of marked vascularity. The crowns of the unerupted teeth were plainly visible in the operative field. The bone cavity was curetted, packed with iodoform gauze and sutured. The patient returned five days later for observation with very little swelling present and no visible suppuration. Seven days later, the operative wound had completely healed and the mucous membrane had resumed its normal position about the adjacent teeth. (Fig. 3.)

Fig. 4.—Benign giant-cell tumor after surgical removal. A portion of the calcified substance is shown *(C.S.)*. (× 2.)

Gross Examination.—The specimen consists of a mass of relatively soft homogeneous light brownish tissue measuring 1.2 by 1.2 by 1.7 cm. Along one surface, there is a thin plate of calcified substance, apparently bone, and forming one border of the growth which at this point is sharply circumscribed. Elsewhere, the surfaces are somewhat roughened as if dissection had been made. (Fig. 4.)

Microscopic Examination.—Paraffin sections from four different blocks of tissue stained with hematoxylin and eosin after decalcification in picric acid reveal a structure made up of two types of cells. The majority of the cells are oval or spindle shaped with long

ovoid nuclei which contain a moderate amount of chromatin in the form of fine granules. Mitoses are lacking. The other cell type is more striking in appearance because of the huge size. The cells are multinuclear, having an abundance of cytoplasm and a very irregular outline. The nuclei have no definite relationship to each other or to any particular part of the cell. Blood channels, apparently lined only by tumor cells, are numerous and well filled with erythrocytes. Trabeculae of well-formed and apparently normal preformed bone occur both at the periphery and in some sections within the tumor. At one point, there is an island of blood-forming marrow, but elsewhere it has been replaced by tumor tissue. (Fig. 5.)

Pathologic Diagnosis.—Benign giant-cell tumor (epulis type) of the mandible was diagnosed.

Fig. 5.—Photomicrograph showing cellular structure of tumor.

CONCLUSION

In benign giant-cell tumor (epulis type) of the mandible occurring in a 6-year-old white girl, the clinical and pathologic findings agree with the conclusions of Geschickter and Copeland as to the relationship of such tumors to cartilaginous centers of ossification in the mandible.

THE POSSIBILITIES OF SIMPLIFIED INSTRUMENTATION IN CAVITY PREPARATION AND FILLINGS*

By R. W. RULE, D.D.S., San Francisco, Calif.

THE question of dental economics has been distinctly in the foreground of late. It is dealt with in numerous articles in current periodicals; it is discussed in the editorials; it is commercialized by individuals and groups whose interests lie outside but in connection with the profession, and it is earnestly studied by capable committees appointed by our local, state and national societies and even by our government. It has many vexing angles. I shall not attempt here to solve the problem in general, but I hope that the subject matter of my paper may help those who follow it to solve certain phases of the economics question in their individual practices.

On the assumption that efficiency is the basis of economic production in every line, may we not say that it strikes close home in a consideration of dental economics?

Our present standards of technic are high. This usually means that the conscientious, capable man either makes his work profitable to himself by charging a fee beyond the means of the average patient or meets the patient's requirement at an economic loss to himself. Neither of these conditions can continue long in the average practice, and yet we must not lower our standards.

On the contrary, the operator, in order to meet these high standards and still produce at a cost which will be profitable to himself and also within the means of his patient, must become the master of simple, rapid technics which will insure against costly "remakes."

It has long been recognized as a principle that careful planning of work and following adherence to this plan with definite systematic steps in proper sequence makes for efficiency in any technical procedure. This principle seems not to have been sufficiently realized and put to work by the very large majority of dental operators. Apparently, it has been difficult to present the story effectively to the undergraduate students. Perhaps the teachers themselves have been poorly trained or inefficient, and relatively few after graduating voluntarily develop it for themselves to the high degree which is possible.

A systematic instrumentation was given us by G. V. Black many years ago. During a long period of teaching of graduates and undergraduates, the effort has been made to simplify instrumentation still farther, but it has been observed that few men can follow a definite instrumentation from book or lecture instruction.

With this in mind, and a recognition of the value of visual demonstration in

*Illustrated by moving pictures.

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventy-Third Annual Session of the American Dental Association, Memphis, Tenn., Oct. 22, 1931.

teaching, a plan was conceived to make large cutting instruments like our chisels, hatchets and hoes, to the same scale of enlargement as our eight diameter plaster teeth and arches which are used in teaching. These could then be used in class instruction actually to prepare the cavities in the large plaster teeth set in their places in the arch, showing the various steps of simplified technic in proper order and on such a scale as would permit a fair sized audience to see what was being done.

These instruments were designed in January of this year and their use demonstrated before the classes in the University of California in February and March, and before the Berkeley Dental Society, March 9, 1931.

They were used also in a university extension course given in San Francisco from March 18 to May 12. The results were at once apparent. Students were enthusiastic about the help that they received in visualizing the instrumentation and the time they saved by putting it into effect. In other words, it made the simplified instrumentation mean something to them.

My purpose today is to present this story effectively to you by word of mouth and in moving picture. We must confine ourselves here to one type of cavity preparation and filling, and I have chosen a Class III cavity and gold foil filling. The principles are applicable to any part of the mouth and any kind of work. The instrumentation will vary somewhat with the case; but the important point is to learn to apply a definite system with steps in regular sequence, holding oneself rigidly to the plan for a few times until its advantages are realized.

We begin by studying the case. 1. Study the occlusion. Estimate the stress likely to come on the finished operation that provision may be made for strength, anchorage and resistance. 2. Consider the susceptibility. Visualize the outline with reference to placing margins in areas of relative immunity, at the same time considering the esthetic features. 3. Visualize the steps of preparation. Select and lay out the instruments on the bracket table in the order of their use. A good assistant can do this as you call them off to her, if you wish. 4. Cleanse the mouth and adjust the rubber dam.[1]

CLASS III CAVITY PREPARATION

The study of the case has taken only a few moments, but the work has been well visualized mentally and the instruments carefully laid out. For efficiency, it will be necessary to follow each step in order, to its completion, forcing oneself to do all that can be done, or that is designed to be done, with the instrument in hand before it is laid down. Then it can be put aside, not to be used again.

It is at this point that there has been a great deal of waste motion and lost time, and those who have been in the habit of "puttering," a stroke here and a scratch there, laying down an instrument before it has accomplished its work and going back to it again and again will need to discipline themselves in adhering closely to the outlined instrumentation. Its advantages once learned, they will never leave it again though they may have to vary it somewhat for different cases.

Instrumentation and Steps in Preparation.—All instruments should be very sharp, and an instrument which has lost its keen edge should be resharpened at once or laid aside. Instruments that have lost their temper should be discarded, and when a number of them have accu-

1. Rule, R. W. Rubber Dam: Its Use and Adjustment, Pac. D. Gaz., 39:541 (Aug.) 1931.

mulated, they may be sent back to the manufacturer for reconditioning.

Step 1. With a Wedelstaedt chisel 10 width, open the cavity by breaking down the undermined enamel from labial and lingual aspect. In some cases, where caries is toward the lingual aspect, a 6-2-12 hoe may work best. This will be determined in the preliminary visualizing of the steps of preparation. When the enamel is not sufficiently undermined to be broken in with a small cutting instrument, a small round bur may be used for entrance followed by a No. 33½ inverted cone bur for undermining.

Step 2. With an inverted cone bur No. 33½ or 34, establish the outline location of gingival angles. This is the crucial point in time saving for this preparation, because a failure to get them in the right place before leaving them means not only repeating this step, but also some, if not all, of the intervening steps. Hold the handpiece at such an angle to the tooth as will cause the end of the bur cutting the gingival wall to give the desired convexity to that part of the gingival outline. Then revolving the bur from the dentin toward the outer surface of enamel, cut with the side of the bur for the necessary labial or lingual extension. Develop your judgment and skill on this step until you can make the proper extension quickly and accurately and not have to return to it later. Left hand burs may be used where indicated, if desired.

Step 3. With a Wedelstaedt chisel 15 width, complete the outline except the gingival. Starting at the incisal margin, make the incisal slope, a short straight line at about a 45 degree angle to the long axis of the tooth. Now, continue with a short graceful curve to meet the labial outline, which should be straight and in the long axis of the tooth or parallel to the developmental grooves. As the chisel approaches the gingival angle, round off slightly to meet the gingival outline so as not to leave a sharp angle within the range of vision. The same procedure with the same instrument is followed now for the lingual outline.

Step 4. With hoe 6-2-12, complete the gingival outline, making the linguo-axial, labio-axial and gingivo-axial line angles. The linguo-axial and labio-axial angles should be obtuse to avoid weakening the lingual and labial walls. They had better be left indefinite in any case where definite angles would undermine or weaken the walls, especially the lingual.

Step 5. With spoons 10-6-12, right and left, remove remaining decay, if any. In small or shallow cavities, this step will be omitted, since there will be no remaining decay after the cavity has been shaped.

Step 6. Sink a round bur No. ½ very slightly into the dentin at the gingival angles, holding the handpiece at such an angle as to cut at the expense of all three walls and avoid undermining the enamel of either wall. The object of this is to make a slight undercut and prepare the way for the next step.

Step 7. With a pair of small angle formers, follow the line angles into the depressions made by the round bur, making the gingival angles definite, acute and slightly undercut for retention. Use these instruments for making the gingival cavosurface bevel, which can be done at this time to avoid the necessity of taking up the same instruments again.

Step 8. With a hatchet 3-2-28, make the incisal retention form, with a sweeping, swinging motion, cutting diagonally into the dentin rather than just beneath the enamel. Where we must extend or penetrate some distance into sound dentin, a No. 33½ bur may serve best.

Step 9. With a Wedelstaedt chisel 15 width, plane enamel walls and make the cavosurface bevel. This instrument will answer for all of the planing and cavosurface beveling except the gingival wall and margin, which have already been taken care of in Step 7.

Step 10. Pliers, cotton and air syringe are used for final cleansing of the cavity. During the preparation of the cavity, the assistant should keep the cavity free from cuttings and débris by a constant or frequent use of the air syringe. As a final cleansing step, the cavity walls should be brushed or swept with a pellet of dry cotton and any particles thus loosened removed by a blast of air.

Placing the Gold Foil—The assistant has removed the cutting instruments from the bracket table. The condensers selected for the case, with Black's holding instrument, are laid out in order.

The assistant should have the alcohol lamp, the gold foil box, hand mallet and

annealing point in readiness on a small stand or bracket table, behind and a little to the left of the chair, a table which may be shifted easily according to the position in which she may be required to stand. She is to pick up, anneal and pass the gold with her right hand, and use the hand mallet with her left hand, giving two light blows for each thrust that the operator makes with the condenser.

The gold is prepared by cutting and rolling sheets of No. 4 foil into pellets of the following sizes: $\frac{1}{64}$, $\frac{1}{32}$, $\frac{1}{16}$ and $\frac{1}{8}$. Average Class III operations are made mostly with $\frac{1}{32}$ size pellets.

Step 1. With the holding instrument in the left hand and 5-3-3 condenser in the right hand, condense a pellet in the linguo-gingivo-axial angle with hand pressure and follow with one or two pellets condensed by combined hand pressure and mallet force.

Step 2. While holding the gold already condensed into the linguo-gingivo-axial angle with the holding instrument, add gold and build along the gingivo-axial line angle till the labio-gingivo-axial point angle is reached, and, changing the line of force of the condenser, mallet the gold firmly into the point angle, thus wedging it between the lingual and labial walls.

Step 3. With the same instruments continue to build gold, increasing the bulk until the gingival margin is covered.

Step 4. Now build along the linguo-axial line angle, changing the line of force as the incisal angle is reached and wedging carefully into the incisal anchorage. In most cases, the condenser 5-3-3 may be used, but, in a few cases, to get access and correct line of force, it will be necessary to change to a bayonet 5-2-0 or 5-1-0 or to condenser 5-3-23.

Step 5. You should now be through with the holding instrument, which should be laid aside. With the mouth mirror in the left hand and working by indirect vision, increase the bulk of gold gingivo-incisally, working mostly from the lingual embrasure until the lingual contour is completed.

Steps 6 and 7. Carefully cover the incisal margin from the labial embrasure and tightly wedge the gold for the contact point between the mass already condensed and the surface of the proximating tooth. The gold here should be well malleted and the wedging principle made full use of in order both to give a hard mass of gold for contact wear and to spread the teeth apart slightly, thus permitting enough surplus gold for finishing and still leaving a tight contact.

Step 8. Return to the gingival area and, adding gold, build gingivo-incisally until the labio-axial line angle is filled and complete the labial contour.

Step 9. After condensation, force an L. J. Mason 3 wax carving instrument between the teeth at the gingival area and, with a wedging, swinging motion, press toward the contact point, wedging as close to it as possible. Repeat this from lingual, labial and incisal embrasures, carefully controlling the instrument against slipping. Follow this with a foot condenser that will reach well into the embrasures, especially at the gingival margin for final condensation, and then burnish with a pair of Nos. 10 and 11 spoon shaped burnishers. Use rather heavy hand pressure and burnish toward all margins.

Finishing the Filling.—The assistant has again removed the instruments from the tray and the finishing materials have been brought out.

The purposes to be accomplished in finishing fillings are (1) perfect restoration of tooth form for (*a*) function and (*b*) esthetic appearance; (2) perfection of margins and continuity of filling and tooth surface for (*a*) permanence of operation and preventing recurrence of decay and (*b*) perfect compatibility with soft tissues; (3) perfect smoothness and polish to prevent lodging places for débris and bacteria.

Step 1. With $\frac{8}{8}$ triple 0 garnet disks lubricated with white petrolatum or cocoa butter, work down to the margins and trim to form as far into the embrasures as the disks will reach.

Step 2. With a 7 Wedelstaedt knife and Nos. 1 and 2 Craig-Rule files, trim the proximal surface to form, working well up to and around the contact point with the knife trimmer and again use the No. 3 wax carver to wedge and burnish around the contact point.

Step 3. With an extra narrow fine garnet strip passed through at the gingival area, strip down to the gingival margin and along the proximal surface as far as the strip will go toward the contact point.

Step 4. With ⅝ regular grit cuttlefish disks, lubricated, finish down to a smooth surface along the margins and into the embrasures and follow with fine cuttlefish disks.

Step 5. Adjust the separator and finish the contact point with a wide pumice strip followed by a polishing strip.

Step 6. Polish with a rubber cup and dry polishing powder.

The rubber dam is now to be removed and the gingival tissues carefully douched and massaged, and the operation is complete.

COMMENT

The effort has been made to set forth as concisely as possible those principles which make for efficiency and high standards combined. The subject matter presented is not based on superficial and untried methods, but has been carefully worked out and put to the test by many men and, where faithfully followed, has made good operators even better and has helped to make excellent operators of men who were classed as poor. It applies not to one special type of work, but, in principle, to all operative procedure.

It does call for study and close application of the principles of efficiency and if one will discipline himself rigidly in these, he will soon find not only that he is working more rapidly but also that gradually he is producing a higher standard of work.

SUPPLEMENT: SIMPLIFIED INSTRUMENTATION

GENERAL DIRECTIONS FOR CAVITY PREPARATION

Examine case, study occlusion, estimate stress and susceptible and immune areas, visualize the outline, plan the instrumentation and lay out the proper instruments in sequenial order, on the bracket table.

SMALL SIMPLE CLASS I CASES IN UPPER BICUSPIDS OR MOLARS

1. With a round dentate bur No. 502 or 503, open the cavity through pit or groove to the dentino-enamel junction, but no deeper.
2. With an inverted cone bur No. 34, follow out the grooves at the depth of enamel in the bottom of the groove.
3. With a Wedelstaedt chisel 10 or 15 width, complete the surface outline.
4. With a hoe 6-2-12 or 8-3-12, smooth the pulpal wall, and make the line angles and point angles.
5. With a Wedelstaedt chisel, plane the walls and cavosurface angle.
6. With a chip blower, cotton pliers and cotton, make the final cleansing of the cavity.

SMALL SIMPLE CLASS I CASES IN LOWER BICUSPIDS OR MOLARS

Follow the same directions but use contra-angle handpiece instead of straight handpiece in steps 1 and 2, and enamel hatchets 10-6-12, right and left instead of a chisel in step 3.

LARGE SIMPLE CLASS I CASES IN UPPER MOLARS

1. With a round dentate bur No. 503 or Wedelstaedt chisel, open the cavity.
2. With an inverted cone bur No. 34 or 35, follow out the grooves.
3. With a Wedelstaedt chisel 15 width, complete the surface outline.
4. With a hoe 8-3-12 or 12-8-12, smooth the pulpal wall and make the line angles and point angles.
5. With spoons 10-6-12 or 15-8-12 right and left, remove remaining decay, if any.
6. With a Wedelstaedt chisel, plane the walls and cavosurface angle.
7. With a chip blower, cotton pliers and cotton, make the final cleansing.

LARGE SIMPLE CLASS I CASES IN LOWER MOLARS

Follow the same directions but use contra-angle handpiece instead of straight handpiece and enamel hatchets 15-8-12, right and left, instead of chisel in step 3.

COMPLEX CLASS I CAVITIES

Follow the same directions as in small simple Class I cavities in upper molars, except that a distal cutting Wedelstaedt and 12-8-12 or smaller hoe will need to be added in step 3 for completing the outline.

CLASS II: MESIAL SURFACE OF UPPER BICUSPIDS AND MOLARS

1. With a Wedelstaedt chisel 10 or 15, open the cavity on the proximal surface, or use a 503 dentate round bur to open the occlusal pit.
2. With an inverted cone bur No. 34 or 35, follow the grooves and widen the occlusal step as much as is necessary.
3. With a Wedelstaedt chisel 15 or 20, widen the step portion and gain better access to the proximal portion.
4. With an inverted cone bur No. 33½ or 35, establish the gingival angles. (Important.)
5. With a Wedelstaedt chisel 15 or 20; complete the outline and square up the buccal, lingual and axial walls, working toward box form.
6. Use a bur No. 33½ in point angles, if necessary, and then a hoe 12-8-12 or smaller for the gingival and pulpal walls and all line angles and box form.
7. With spoons 10-6-12 or 15-8-12, remove remaining decay, if any.
8. Use a fresh Wedelstaedt chisel 20 for planing the walls and cavosurface bevel.
9. Use gingival margin trimmers for the gingival cavosurface bevel.
10. Use a chip blower, cotton pliers, and cotton for the final cleansing.

CLASS II: DISTAL SURFACE OF UPPER BICUSPIDS AND MOLARS

Follow the same directions except that enamel hatchets 15-8-12 and 10-6-12, right and left, may be needed in steps 5 and 6 in the molars and occasionally in the bicuspids.

CLASS II: IN LOWER BICUSPIDS AND MOLARS

Follow the same directions but use contra-angle handpiece, instead of straight handpiece, and enamel hatchets instead of chisels in steps 3 and 5 and in addition to the hoe in step 6.

CLASS III: INCISORS AND CUSPIDS

1. With a Wedelstaedt chisel 10, open the cavity.
2. With an inverted cone No. 33½, establish the gingival angles. It is important to gage this step accurately.
3. With a Wedelstaedt chisel 15 complete the outline.
4. Use hoe 6-2-12 for axial line angles.
5. With spoons 10-6-12, right and left, remove the remaining decay, if any.
6. With round bur No.½, slightly undercut gingival angles.
7. With angle formers, make the gingival point angles.
8. With a hatchet 3-2-28, make the incisal anchorage.
9. With a Wedelstaedt chisel, plane the walls and make the cavosurface bevel. Angle formers may be used for the gingival margin.
10. Use a chip blower, cotton pliers and cotton for the final cleansing.

CLASS IV: INCISORS AND CUSPIDS

1. With an S.S.W. stone No. 11, 37 or 38, shorten the labial and lingual plate.
2. With a Wedelstaedt chisel, break down the undermined enamel.
3. With an inverted cone bur No. 33½ or 34, establish the gingival angles.
4. With a Wedelstaedt chisel, complete the outline.
5. With an inverted cone bur No. 33½, make the incisal groove.
6. With a round bur No. ½, slightly undercut the gingival angles and follow with angle formers or hoe 6-2-12.
7. With a hoe 6-2-12 or Wedelstaedt chisel 10, make line angles.
8. With spoons 10-6-12, remove the remaining decay, if any.
9. With Wedelstaedt chisel 15 or 20, plane the walls and make the cavosurface bevel.
10. Use a chip blower, cotton pliers and cotton for the final cleansing.

CLASS V

1. With spoons 10, 15 or 20 width, according to size of cavity, remove superficial decay.
2. With an inverted cone bur No. 34 or 35 or an equivalent fissure bur, extend the cavity.
3. With a Wedelstaedt chisel, complete the outline.
4. Use a hoe 6-2-12 or larger for line and point angles.
5. With a Wedelstaedt chisel, plane the walls and cavosurface angles.
6. Use a chip blower, cotton pliers and cotton for the final cleansing.

DISCUSSION

R. K. Brown, Ann Arbor, Mich.: Dr. Rule has developed a plea for standardization and simplification of operative procedures. The introduction to his paper leads one to believe that he is motivated by a desire to aid the dentist to operate with greater celerity and in a more efficient manner, and yet meet the high ideals that present-day operative technic has made possible. The dentist is face to face with the fact that, in order to maintain the high standards or ideals that are possible in modern restorative work, he must either charge a fee that is beyond the reach of all but a few of his patients, or perform the work, as Dr. Rule states, at an economic loss to himself. Dr. Rule's answer to this condition is, "a mastering of a simple, rapid technic that will insure against remaking," and if the steps of these technics are systematized in proper sequence, efficiency will naturally result. The economic aspect of operative work is important but should be relegated to a less conspicuous place. Correct habit formation in youth is a desirable asset and correct habit formation in operative procedures is invaluable to the student entering on his clinical career, for it will aid him in developing his capacity and ability throughout his professional career. This alone is an adequate reason for a study such as Dr. Rule has undertaken. G. V. Black placed cavity preparation and the filling of teeth on a scientific basis years ago. He presented systematic and detailed instrumentation, cavity preparation and methods of filling teeth, and his work is a guide to basic principles in the operative field. At the present time, we follow his procedure in cavity preparation, use his instruments or modifications of them and cut cavities in the way that he advocated over a quarter of a century ago, little realizing that if Dr. Black were alive today, he would change his preparations and instruments to meet the newer developments in the operative field that have come with improved filling materials, with more efficient instruments and with present-day advancements in preventive dentistry and oral hygiene. It is difficult to discuss a paper with which one agrees as fully as I do with Dr. Rule's, for his main theme is unassailable. However, I feel that the presentation of his ideas would be more logical and comprehensive to his readers if he followed Dr. Black's system more closely. To be more explicit, when Dr. Rule describes the preparation of a Class III foil cavity, he gives his procedure as step 1, step 2, etc.; whereas, if he used the seven steps of procedure in cavity preparation listed by Black, that is, outline form, resistance form, etc., his explanation would be more comprehensible to the reader. These steps overlap in many instances, and their order changes with different filling materials, but they are the accepted terminology of operative men and should be used in a scientific presentation of this subject. This is merely a personal opinion and Dr. Rule has probably a very good reason for his manner of presentation. We have found that placing another step, gaining access to the cavity, before outline form, has been an aid in presenting these steps of procedure in cavity preparation to our classes. We have five classes of cavities. The instruments, procedure in cavity preparation and the technic in the use of the various filling materials for restorative work on each of these five classes of cavities might well be written up in a systematic, simplified way. Concerted effort might then be made by dentists to simplify these procedures and thus increase efficiency with a lessening of the time element involved in pursuing restorative work. There are certain other important factors in securing this result. We must not ride a bicycle in a motor age; neither must we attempt to do modern dentistry with the equipment of 1910. A man is known by the company he keeps, and a workman is known by his tools. Systematization of instruments in the cabinet, that is, a place for everything and everything in its place, is necessary for time efficiency, and cleanliness must be a bedfellow of this orderliness. Our instruments must be sharp, and we must know how to keep them sharp. Condensers can be reserrated, and cutting instruments can be retempered if it is necessary. As our armamentarium is simplified, a greater need for system will be necessary, system in instrument arrangement, care, and use. Conzett and Volland have made a statement in the "American Text Book of Operative Dentistry" that we would like to place in letters of fire in our operative clinic: "The multiplication of instruments beyond that necessary for the accomplishment of the desired operation is the multiplication of confusion." We all know the putterer who makes a stroke here or a cut there, lays the instrument down,

reaches for another, and, during his entire procedure of cavity preparation, uses burs, stones and instruments far in excess of the requirements of the case in hand. The beginner may be forgiven for this fault and his teachers criticized if it is not soon remedied, but the practitioner has no excuse for developing his operative technic in this manner. Didactic presentation of operative principles is made to large groups, and it is essential that this presentation be given in a simple and systematic manner. This is the duty of the teacher, and he must watch the clinical application of these principles so that the student may have that desirable habit formation developed early in his operative career. This is an obligation and responsibility that rests upon the shoulders of the dental teacher, as well as upon those of the student. Standardization of instrumentation, cavity preparation and the filling of teeth would seem to be desirable; for how can we have a simplified system without standardization? *Can* we standardize? We are working on a human organism which offers many atypical forms. The human organism is not standardized. We dentists are not standardized; we are tall, or short; we have long thin fingers, or short thick ones; and we have many other dissimilarities which force us to consider that hypothetical yet real "personal equation." The individual must be merged into the social whole, and it would seem best for us, as dentists, to follow a simplified system that has been standardized by our predecessors. Later, as the personality and individual ability of an operator develop, he may digress from the established order and perhaps improve upon it, but this will be the lot of but a few, for the vast majority of us will follow the beaten path, which will mean safe and satisfactory accomplishment. Dr. Black, Dr. McGehee and Dr. Rule have all given us a systematization of operative procedures, and let us hope that more will be forthcoming, for each addition to our mite of knowledge eases the load of those who are to follow in our footsteps and to minister, in a small way, to the ills of humanity. Let us plan our work and then "work" our plan.

SOME ESSENTIAL CONSIDERATIONS PERTINENT TO FIXED BRIDGE RESTORATIONS*

By ARTHUR O. KLAFFENBACH, D.D.S., Iowa City, Iowa

A CONSIDERATION of the restoration of oral function in mouths mutilated or rendered less efficient by the loss of teeth may be approached from at least two different angles. One method consists in concentrating on the edentulous space or spaces to be restored without due consideration of the entire masticating apparatus as a unit, the decision as to the type of restoration to be employed being arrived at by means of a haphazard examination or so-called "snap judgment."

Such restorations, in their final analysis, lack association and unity because the preventive and health aspects have not been included in the picture. In many instances, the failure of such replacements has not been due to improper design or faulty mechancial construction, but to failure to recognize the need of correlated data and to establish functional occlusion and occlusal harmony.

The other method involves a comprehensive survey of the individual, and the

*From the Department of Clinical Crown and Bridgework, State University of Iowa.

*Read at the Seventy-Fifth Annual Meeting of the Northern Ohio Dental Association, Cleveland, June 8, 1932.

entire oral cavity. Such a survey should include a physical, clinical, roentgenographic, and bacteriologic examination, and a study of the existing occlusion by means of carefully prepared and anatomically mounted study casts as diagnostic data, together with a consideration of the prognosis of the case.

In the oral cavity, existing conditions must be determined, including the condition of the remaining natural teeth and their supporting structures, existing lesions, pulp, root-canal and apical conditions, malposition, trauma, orthodontic possibilities and occlusion, with a consideration of the entire mouth as a unit. These findings are correlated to determine the treatment necessary prior to the replacement, and to aid in determining the type of replacement that will best restore and maintain occlusal harmony, functional occlusion and a state of health.

We all realize that the loss of a single tooth decreases masticating efficiency. Units thus mutilated (provided no restorative or preventive measures have been instituted) become more crippled and inefficient as a result of change in position of the teeth, tissue involvement, occlusal disturbances and the changed relationship of the mandible to the maxillae.

With our broader conception of occlusion, we are more and more confronted by and impressed with the importance of having or establishing occlusal harmony and cuspal coordination of the remaining natural teeth in all masticating ranges before beginning the actual restoration of the edentulous spaces.

Since the maintenace of functional occlusion so established is directly dependent on the restoration supplied, it is obvious that the denture must be so designed and constructed that it will prevent further migration of the teeth and maintain the previously established functional occlusion, coordinating with the natural teeth not only in centric occlusion, but also throughout all functional ranges.

If our study casts are to convey to us a true picture of the case, they must be accurate in every detail. They must be made of metal, amalgam or artificial stone in order to withstand the surface wear, breaking or nicking of cusps and other mutilation which might impair their diagnostic value. In addition, these casts must be transferred to an anatomic articulator capable of maintaining and reproducing the various mandibular movements.

The question as to what kind of instrument to use for this purpose has been discussed pro and con many times. At present, the outstanding opinions may be divided into two general groups, one group establishing occlusal coordination arbitrarily by means of the "spherical theory," the other group sustaining the view that the condylar movements are the controlling factor, and establishing occlusal coordination by means of the "theory of condylar influence."

A check-up of many of these cases reveals the fact that there is a marked variation in the degree of condylar path inclination, in the size of the condyles and in the fossae shapes and depths, all having an influence on the temporomandibular articulation, mandibular movements and the occlusion of the teeth.

If we are to consider these variations, it seems only logical that an anatomic instrument must be used which will permit condylar adjustment and cuspal guidance equivalent to those existing in the patient.

The technic for mounting study casts

of the natural dentures and for subsequent adjustments of the instrument are in principle the same as those outlined in the intra-oral technic for the Hanau articulator model "H" for full denture construction.

With accurate artificial stone or metal study casts of the natural dentures on hand, the maxillary cast is attached to the articulator with the aid of the facebow. A sheet of soft wax is placed on the bitefork, the patient biting into the softened wax to make an impression of the occlusal surfaces of the upper teeth. With the aid of these, the upper cast is mounted on the articulator.

The mandibular cast is attached to the articulator in centric relation to the maxillary cast, with the aid of the centric wax relation record. This record is made by placing in the patient's mouth a thin layer of wax softened throughout; the patient closing in centric relation, without pressure, to make an impression of the upper and lower occlusal surfaces in centric relation.

The articulator is then adjusted with the aid of the intra-oral records, softened wax being placed in the mouth and the patient gently closing in the desired protrusive or lateral jaw relation.

The protrusive record is made by having the patient protrude the jaw about 6 mm., which, in some cases, may be beyond edge to edge relation. For this purpose, the wax bite takes the place of the occlusal rims and serves to adjust the horizontal condylar guidance.

The Hanau formula may serve to adjust the lateral guidance. If desired, two lateral records (right and left), consisting of softened wax placed between the occlusal surfaces, on the balancing side, may be used instead of the formula.

With the proper orientation of the study casts to the articulator, one is better able to study the varying degrees of occlusal discrepancies in all ranges of mastication; to determine the method of procedure necessary to establish and maintain functional occlusion, and to explain to the patient existing conditions and restorative requirements.

Having carefully studied the case and correlated our findings, we can more readily determine how best to bring about a harmonius relationship of the cusps and inclined planes of the natural teeth during the various movements of the mandible, and to decide whether this is to be acquired by grinding, opening the bite or orthodontic measures or a combination of these procedures.

With such an exacting technic, the end-results should very closely approach the ideal, provided care has been exercised in the selection of cases. Unfortunately, the great majority of patients in the average practice cannot afford such extensive treatment. Under such circumstances, it may be deemed advisable to compromise our efforts, and, as nearly as possible, restore a masticating efficiency consistent with existing conditions.

Before leaving this important consideration of reconstruction and occlusal coordination, I wish to call your attention to some of the more simple cases. While accurate study casts mounted on an anatomic articulator provide the most efficient means for study, there are some cases in which a slight degree of occlusal disharmony exists that can be readily corrected directly in the mouth, examples of such cases being found in the cuspid region during lateral excursions of the mandible, or where one upper incisor tooth makes contact with one or two lower incisor teeth, preventing contact of the posterior teeth, when in protrusive occlusion.

Drs. McCall and Stillman have given

us a technic for grinding in such cases. By observing the teeth as the mandible glides into the various occlusions and by noting the facets of wear on the teeth, with the aid of articulating paper, one can readily detect a "tripping" or the presence of traumatic occlusion. If occlusal disharmony or actual tooth displacement is found to exist, grinding is then resorted to, articulating paper or petroleum jelly and lamp black being used to aid in locating the exact spot where grinding is necessary.

With the mouth restored to a state of health and the establishment of functional occlusion, the next consideration is occlusal stress. Since it has a direct bearing on the health of the abutment teeth, opposing teeth and supporting tissues, in the life of the restoration, care must be taken to avoid undue lateral stresses and excessive overloading by preventing occlusal interference and limiting the restorations to short spans.

STRESSES

So far, lateral stresses have not been measured, but clinical evidence has proved its disastrous and injurious effects. As regards vertical stresses, Dr. Black demonstrated that it requires from 45 to 60 pounds to crush beefsteak (well done), while the toughest cuts required from 70 to 90 pounds. Dr. Head utilized a triturating force and found that he could reduce the pressure required to from 38 to 42 pounds for tough steak.

With the gnathodynamometer, we have tested many bites on natural teeth, full dentures and removable and fixed bridges. In our recent Junior class there was a range of from 70 to beyond 275 pounds. We found that the biting stress of full upper and lower artificial dentures averaged about 20 pounds, removable bridges with wrought clasps about 26 pounds and fixed bridges about 55 pounds. While these figures are more or less relative, it shows that the fixed bridge supported entirely by abutment teeth comes nearer restoring masticating efficiency than do the other types of dentures. It also demonstrates that our problems of stress and overload cannot be standardized or solved on a mechanical basis owing to the great variation in individuals, and that our conclusions regarding the design and construction of the restoration must be based on clinical findings and past experiences, limiting the application to strong, vital abutment teeth with adequate support and to short spans so constructed that they will function in harmony and where the pulp can be conserved and the vitality of the pulp maintained.

PREPARATORY TREATMENT OF ABUTMENT TEETH

The preparatory treatment of the abutment teeth should always include the removal of all fillings, cement bases and decay. It has been our clinical experience that, in about 98 per cent of cases, this procedure is justified because of the conditions found under these old fillings and crowns. For this reason, if we are to have the foundation of our restoration in the best possible condition, it is essential that the abutments or attachments be placed in or on teeth which we know to be free from decay, and in which every effort has been put forth to preserve the pulp in a normal, healthy condition and to prevent any future recurrence of decay.

With the aid of the rubber dam or cotton rolls, the tooth is kept dry. The old filling and decay is then carefully and thoroughly removed and the surfaces sterilized with phenol, Howe's ammonical silver nitrate solution, neutral acriflavin or a drug of similar effectiveness. In some cases, especially when the cavity

is deep or the tooth is sensitive, sterilization is followed with an application of cavity lining or an anodyne dressing or paste of eugenol and zinc oxid or thymolized calcium.

Red copper cement is then used where discoloration is of no concern, or an oxyphosphate of zinc cement is used in cavities where darkening of the tooth is a consideration and must be avoided. The cement should be mixed on a cool slab, small portions of powder being incorporated into the liquid until a thick putty-like consistency is obtained, the heat or free acid being thus reduced to a minimum to prevent undue irritation to the pulp. The use of a matrix will greatly facilitate proper placement of the cement in those teeth requiring restoration of the axial walls.

The use of amalgam under crown abutments and in other gold restorations, is not recommended in vital teeth. When amalgam is used, there is always a possibility of the pulp's being effected by thermal changes or electrical disturbances. The existence of oral electricity has been demonstrated in the laboratory or by the jumping or jerking of a patient when a mouth mirror is brought in contact with an amalgam filling. This electrolytic action, the result of two dissimilar metals' being in contact with an electrolyte, which, in the mouth, is the saliva, may also produce a disintegration of gold or affect thin layers of cement. For this reason, the placing of a gold abutment adjacent to an amalgam filling is not deemed advisable and should be avoided.

ABUTMENTS

The selection of adequate abutments entails many considerations, such as stress, length and alinement of span, types and lengths of tooth crowns, prevalence of or immunity to caries, age, sex, location, contact points, condition of tooth and type of tooth.

Conservation of the vital pulp should be of paramount importance at all times, and the prevention of thermal and mechanical shock, the result of too close proximity to the pulp and the use of dull burs, untrue stones or faulty technic should be avoided. We must bear in mind that, when preparing these cavities, or in preparations for crowns, in many instances we are cutting away in a few minutes what would require a long time if produced by caries, and that, during the time that the process of decay is active, Nature has been fortifying the pulp by means of secondary dentin and pulp recession.

Furthermore, the cavity should always be protected against the invasion of saliva or infection, with medicocement or a similar agent, and thus infection and sensitiveness be prevented.

While an abutment should have a reasonable amount of frictional retention, the compression of dentin by a tight fitting abutment may have a very serious effect on the pulp. On the other hand, an abutment should be self-retaining, and any inlay abutment which must be held in place with an instrument when being fitted is not adequate for this purpose.

INLAY ABUTMENTS

The inadequacy of the smaller cast gold inlays as bridge abutments has been revealed clinically by many failures. Loosening of the inlay abutment or abutments very soon after placement of a bridge, marginal caries and opening of the gingival margins all bear witness to the fact that they lack strength and sufficient grip, in many instances, to withstand torsional and other stresses.

We must also concede that the inlay abutment has been greatly abused, in

both application and construction, as evidenced by these failures.

The use of small or thin inlay abutments; the use of gold entirely too soft; inadequate cavity preparation resulting in the lack of retention; poorly fitting inlays as a result of poor cavity preparation, wax patterns and faulty casting technic, faulty manipulation and cementation, the use of cheap or inferior cement, too great dependence on cement for retention, and failure to seat and maintain the inlay in proper position until the cement has set; the use of extensively decayed or devitalized teeth; failure to have cavities parallel with each other, and the loss of relation due to shrinkage or faulty technic during the soldering process, or when taking impressions, pouring or mounting the casts, have all been factors in these failures when they have not been so carefully observed as this type of abutment demands.

THREE-QUARTER OR PARTIAL VENEER CROWN ABUTMENTS

While the three-quarter or partial veneer crown is in many instances used for anterior teeth, it is not by any means of universal application, and many of its failures are directly traceable to its use on teeth not anatomically adapted to it.

The square tooth, of average length or longer, with straight proximal surfaces, incisal edges of ample thickness and very little constriction at the neck, is preferable for this type of preparation and abutment.

Other unfavorable conditions are the presence of short teeth, teeth with short distal surfaces and tipped, rotated, tapering and extensively decayed teeth and close bite cases with extremely close lingual contact, any of which must receive due consideration before we decide on this type.

Anterior three-quarter crowns fail at the proximogingival angles and along the incisal edge, and a loosening of the entire abutment results. These failures are due to a poor or too tapering a cavity preparation, use of teeth not anatomically or otherwise adaptable to this type of attachment, shrinkage of castings, generally mesiodistally, or distortion of margins the direct result of not having preparations parallel to each other, causing margins to be bent or distorted in the seating or cementing of the bridge to place.

GOLD CROWN ABUTMENTS

Too little concern for standards of excellence and an overconcern for quick results have, in many instances, brought unwarranted condemnation on the gold crown abutment. But the evils which arise from poorly fitted and badly contoured shell crowns, often placed on teeth permeated with decay, with diseased pulps, partially filled root-canals and involved apices, entirely unfit for abutments of any kind, are not necessarily to be charged against the gold crown abutment.

All gold crown restorations of vital teeth involve at least four very important considerations: 1. The need for conservation of tooth substance and the maintenance of the pulp in a state of health. 2. The advisability or inadvisability of completely covering or incasing the crown portion of a vital tooth. 3. The effects of placing a large mass of gold upon the crown portion of a vital tooth. 4. The possibilities of avoiding gingival irritation and making an anatomic and physiologic restoration.

I shall outline briefly a few facts pertinent to these considerations.

1. In some instances, the preparation of a tooth does not require such deep cutting as for certain types of inlay abutments. If proper precautions are exercised to prevent irritation and shock and cutting the teeth of younger patients is avoided, the pulp should remain in a normal physiologic condition.

2. This involves the debatable question of the possibilities of dentino-enamel circulation. Bödecker, Bunting, Rickert and others are of the opinion that such a circulation does exist, but until we have more definite evidence, and an intimate knowledge of the effects which might result from completely covering the crown of a vital tooth, we are, I believe, justified in this procedure.

3. Our present knowledge regarding the effects of placing masses of gold in or over the crown portion of a tooth is limited possibly to its thermal and electrolytic effects on the pulp. This can be avoided by constructing crown abutments with the minimum amount of gold consistent with strength. The grinding out of considerable gold, or removing a portion of the wax, from the cavity side before casting the crown is recommended in order to reduce the bulk of gold and permit a layer of cement of sufficient thickness for pulp protection and to prevent undue pressure in seating the abutment.

4. It is generally conceded that, because of the gingival tissue involved, the removal of all gingival enamel, without injury, as required for the shell crown preparation, is an exceedingly exacting and doubtful procedure. Furthermore, Drs. Gottlieb, Kronfeld and Mueller have shown the existence of great variation in the gingival crevice and the place of attachment of the gingival tissue, demonstrating the impossibility of removing the gingival enamel to the cemento-enamel junction, especially in younger patients, without laceration of this delicate tissue.

As it is not necessary to remove all the enamel in this area for the cast gold crown, but merely to develop a finishing line just beneath the free margin of the gum, that portion of enamel which is so difficult to remove without laceration, and practically impossible to restore on the crown, is allowed to remain, with its tissue attachments undisturbed.

The gold crown is without a doubt the most retentive type of abutment, but for esthetic reasons its application is limited to posterior teeth, more especially those that are short or extensively decayed, and in those mouths where gingival decay is prevalent. On bell-shaped teeth, the gingival outline should be extended only to the height of convexity to avoid the excessive loss of tooth substance necessary if an attempt were made to carry it beneath the free margin of the gum.

My observation has been that there is a tendency to construct gold crown abutments that are entirely too large when completed. Such restorations, because of the size, do not function properly. With widened occlusal surfaces, the amount of stress is increased and cuspal disharmony created, while the lack of proper contour prevents the correct deflection of food and proper stimulation of the underlying tissues, and food is forced into the gingival crevice.

PONTICS

To avoid the possibilities of abutment teeth becoming sensitive, elongating or shifting, owing to the length of time required to complete the pontics and bridge or bridges, some operators prefer to complete the pontics before preparation and making of the abutments. If the preparations and abutment teeth are properly

protected, there is little danger from these sources, and generally better results, I believe, will be obtained by contouring the pontics to the abutments.

The application of the porcelain tipped pontic has undergone many changes. It has been placed in the tooth socket immediately after extraction; the healed ridge has been lanced to permit embedding of the tip, and it has been placed in heavy contact with the tissue; all of which have been found to be unsatisfactory procedures.

A clinical observation of many cases in which porcelain root-end or root implantation pontics were placed immediately after extraction, and had remained over a period of years, revealed that while externally the tissues gave no evidence of inflammation, nor did the roentgenograms show any pathologic disturbances, on removal of the porcelain tip from the socket at least a portion of the tissue lining the socket was found to be red and glossy, giving evidence of inflammation. When the socket was allowed to remain open a very short time, the inflamed area diminished very rapidly in size, and soon the tissue assumed the appearance of the adjacent mucosa. Smears made from a platinum loop inserted in the socket before the removal of the tip, when examined microscopically, revealed the presence of food débris and micro-organisms. These, in combination with an inflamed condition of the tissue, are potential or active sources of infection.

When, for esthetic or other reasons, it is desirable to make a restoration immediately after extraction of the teeth, it is far better to place a partial denture temporarily than to insert root tips into the sockets of teeth recently extracted.

A temporary partial denture may be made by taking an impression with the natural teeth to be extracted in place. An artificial stone cast is then made, from which the teeth are cut away, and approximating the possible contour of the gum or gingival outline after extraction. On this cast, a partial denture is constructed. The teeth are then extracted and the partial denture immediately placed and worn by the patient until conditions are favorable for a bridge with porcelain tipped pontics just slightly in contact with the ridge tissues.

Porcelain tipped pontics are, when properly constructed, far superior to all others available at the present time, but, unfortunately, they cannot be used where conditions require a short, gingivoclusal or gingivo-incisal pontic.

Of the two forms, the spheroidal tip is preferable to the saddle, being more easily cleaned because of its shape and because of minimum tissue contact.

The saddle tip, which has greater esthetic possibilities in some cases, is indicated principally on anterior bridges where, for esthetic reasons, the spheroidal tip cannot always be used to advantage, and, because of easy excess, the proper prophylactic care can be given the denture.

UNDERLYING TISSUE

Drs. Weaver and MacMillan and others are of the opinion that the cortical plate and underlying tissue are more developed under removable appliances, owing, they assert, to the presence of the intermittent tissue-bearing denture stimulating the tissues.

My observation, based on a roentgenographic study of many of these cases, reveals that when the tissue contacts of the pontics are small, when they do not produce undue pressure or irritation and when they are properly shaped and highly glazed to permit the tissues to be cleaned

and massaged by the food during the process of mastication, and the stimulating effect of intermittent pressure and of the toothbrush are utilized, these underlying tissues are in every way comparable to those of the removable, intermittent tissue-bearing dentures.

It is generally conceded that constant pressure produces atrophy. Intermittent pressure produces deposition of bone. Pressure belongs to the class of mechanical irritants. Persistent application of pressure results in diminution of the blood supply to the part which is thus acted upon, and this results in the absorption of the area to the point where it is no greater than can be adequately supplied by the existing blood flow.

Intermittent pressure has the opposite effect. During the interval where there is no pressure, the regenerative activity of the part begins to build up to the point where it can adequately use the blood supply, which happens to always be greater after the pressure is released than before it was applied.

A fixed bridge certainly produces intermittent pressure as it exerts pressure when the patient is masticating, in addition to this, if the pontic tips or saddles are in such balanced relationship to the underlying structures that the pressure of mastication on the bridge restoration produces intermittent pressure of function necessary to produce bone growth, then, a fixed bridge if properly designed and constructed will produce deposition of bone as it is exerting intermittent pressure.

ASSEMBLY

While the personal equation enters into each method or technic, there are certain fundamentals which must be observed to obtain accuracy of relationship in the completed bridge. The method of procedure must also be varied in accordance with the kind of working cast used. Metal contacts between pontics and abutments are essential. The use of a good gold solder and an efficient blowpipe is imperative. Sectional soldering is deemed advisable. In most cases, one joint is left unsoldered. The bridge is then tried and fitted in the mouth, the joint waxed and a shallow plaster impression taken, after which the bridge is removed and reinvested and the remaining joint soldered.

The completed bridge, when tried in the mouth, should go to place without undue pressure or displacement of the abutment teeth, and if it fails to do so, it must be unsoldered, or cut apart, another impression being taken and the joint or joints resoldered. Under no consideration should a bridge be forced to place and allowed to remain in the hope that the abutment teeth will become adjusted to the new relationship.

The finished solder joint should be as small as is consistent with the strength required, circular and located at the contact point, thus preventing a filling in of the interproximal space and buccal and lingual embrasures.

RELATIVE STRENGTH OF CAST AND SOLDERED JOINTS

As to the relative strength of cast and soldered joints, the 18 and 20 carat gold solders, ranging in fineness from 0.585 to 0.656, seem to have the greatest strength. The strength generally decreases as compared to that of this group when the fineness is either decreased or increased.

Whether cast bridges or pontics may be assembled from separate units by means of solder joints or greater strength may be obtained by casting the case as a unit will depend on the physical properties of the casting gold used. Therefore, if casting gold of a strength higher than that of the solder is used, the soldering will not be so dependable.

The deficiencies of gold solders as compared with the high strength gold alloys and wrought wires have been recognized for some time, and no doubt an improvement will soon be brought

about both as to standardization of specifications and as to strength.

ADJUSTMENT AND PLACEMENT

After polishing, but before the bridge is cemented to place, the occlusion, margins, contact points and tissue contact must be carefully examined and adjustments made where necessary. Sterilization of cavities, protection from moisture, and proper cementation of the bridge are imperative.

The psychology of informing the patient of some of the things to be expected, such as an unnatural feeling or perhaps a feeling of fulness, interference with phonetics and adjustment of the tongue and cheeks all tend toward greater satisfaction during the initial stages of wear.

In a day or two after cementation and placement of the bridge, the patient must return for a rechecking. At this time, the margins should be carefully examined and polished, and the occlusion checked, in all ranges, the operator resorting to spot grinding where it is necessary to relieve trauma or to establish cuspal coordination. Here again, the roentgen-rays are used and roentgenograms should be obtained of every bridge to determine whether there are any particles of cement remaining, any defective or overhanging gingival margins, as a matter of record, to be filed away for future reference.

Before dismissal, the patient should be instructed regarding the use of the toothbrush and dental floss. He should also be made to realize that the life of the bridge will materially depend on his cooperation in following instructions and maintaining mouth hygiene. Also, he must be made to realize the importance of returning at stated intervals for examination.

Finally, let us realize, as never before, our responsibilities, duties and obligations, so that we may render to our patients a prophylactic, a preventive and a health service, always remembering that the fundamental strength of any endeavor, whatever its character and form, is measured by the effectiveness with which it renders service to those whom it serves.

MALIGNANCY AND GROWTHS OF THE MOUTH AND JAWS*

By CARL W. WALDRON, M.D., D.D.S., Minneapolis, Minn.

GROWTHS and malignancy are matters of concern to many of the better informed members of our American communities. When properly directed, this public interest in cancer should result in a greater concern regarding mouth health and the prevention of irritation and infection. The highly complex state of present-day American life makes it imperative to avoid adding to mental problems and stress by unduly increasing the present fear of cancer. Nevertheless, the truth must be recognized and

*Read before the Section on Oral Surgery and Exodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 20, 1932.

the problem met to the best of our ability. The medical and dental professions and the public must have available all authentic information regarding service available in meeting the situation, which must be faced with calm and hopeful perseverence. The battle against cancer is not won, but progress is being made, and one may confidently predict that, by public education and early diagnosis, the incidence and mortality of cancer of the mouth and associated parts can be very materially reduced; for, in no other portion of the body, are there similar oppor-

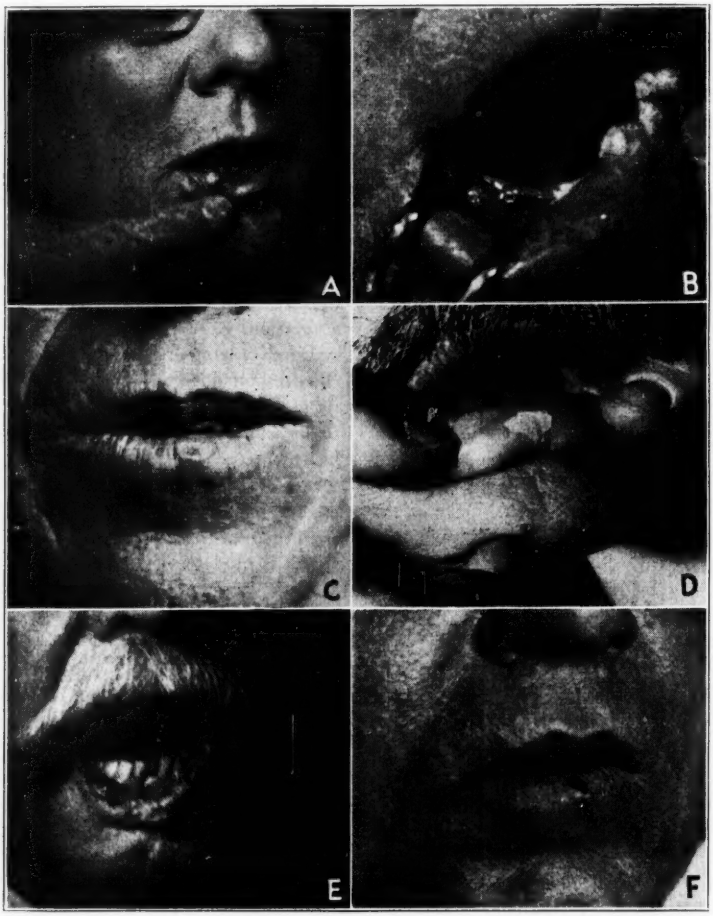


Fig. 1.—Precancerous lesions of lip. *A,* fibroma of lip. *B,* papillary leukoplakia, angle of mouth and alveolar process. *C,* smoker's burn. *D,* smoker's burn, excoriation. *E,* seborrheic keratosis. *F,* papilloma.

tunities for observation by the patient of precancerous lesions and the early stages of cancer. The importance of this opportunity is stressed by many authorities, and the dentist should occupy no small place in the efforts directed toward the prevention and control of oral malignancy.

Four thousand deaths each year are the approximate toll of cancer of the mouth, jaws and lips in America. It is quite obvious that a large proportion of

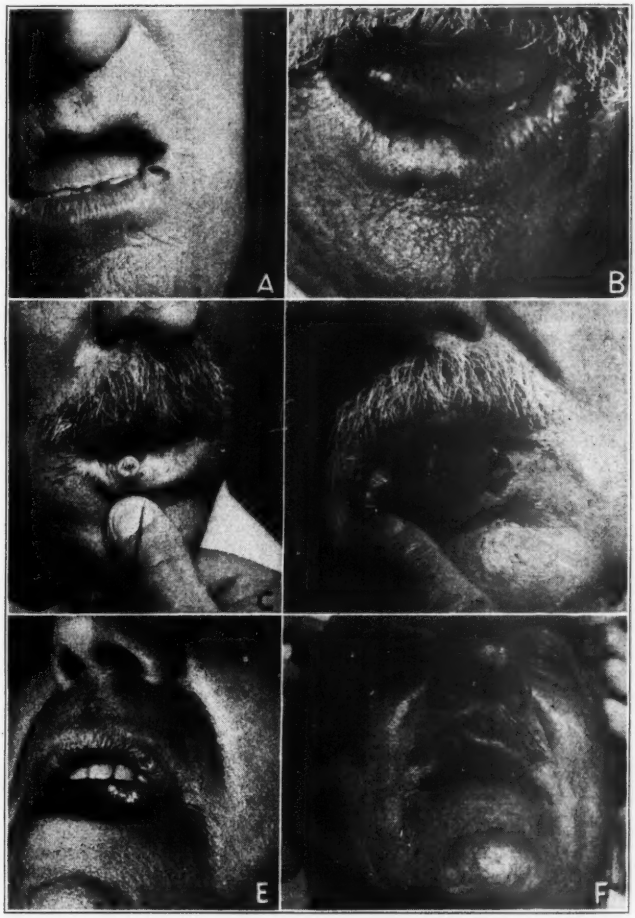


Fig. 2.—Carcinoma of lip. *A*, *B* and *C*, early carcinoma of lower lip. *D*, more advanced carcinoma of upper lip. *E*, early carcinoma of upper lip. *F*, more advanced carcinoma of upper lip.

these deaths should be preventable, and clinical experience impresses one with the infrequency of carcinoma in a healthy mouth. A comfortable, well-kept oral cavity, free from local irritation of the gums and soft parts, is virtually free of the danger of malignant growths, unless the excessive and careless use of tobacco initiates the process.

The importance of the individual dentist's place in the oral hygiene movement in its relation to cancer prevention is too obvious to require elaboration, but a consciousness of his duty and opportunity

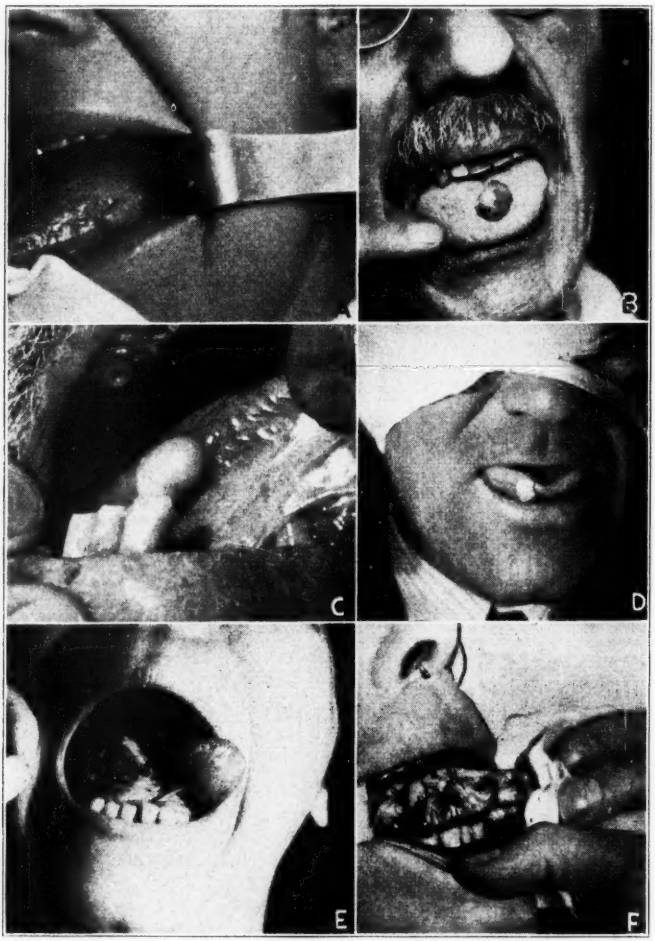


Fig. 3.—Lesions of tongue. *A*, traumatic ulcer and area of irritation. *B*, pyogenic granuloma. *C*, fibroma. *D*, papilloma. *E*, carcinoma. *F*, carcinoma.

should spur him to greater efforts in the cause of oral health.

More active attention should be given by the dentist to the study of the earliest manifestations of malignant growths, in order that he may be able to advise his patients regarding suspicious lesions that may come under his observation. To him may be delegated the carrying out of local treatment for the elimination of dental sources of irritation of the traumatic or infectious type that are directly related to the precancerous lesion. A word of caution must be given concerning

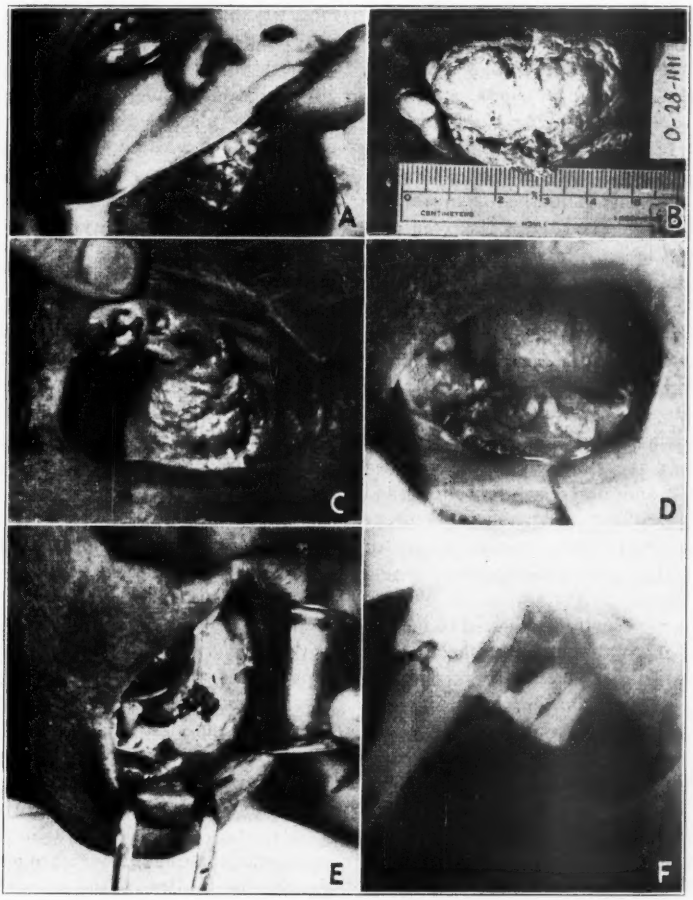


Fig. 4.—Carcinoma of jaw. *A*, papillary infiltrating carcinoma of maxilla. *B*, gross specimen. *C*, papillary infiltrating carcinoma of maxilla. *D*, papillary infiltrating carcinoma of mandible. *E*, leukoplakia and deeply infiltrating carcinoma of mandible. *F*, lateral jaw film showing decalcification from invasion of cancer cells.

the nature of such treatment: No extractions should be performed in areas showing gingival lesions or growths until it has been reasonably well established that cancer has not yet developed. Any unusual appearing area of the alveolar process as revealed by the dental roentgenogram should be looked on with suspicion. Preliminary dental treatment should be limited to the elimination of sources of irritation, such as sharp or jagged enamel margins or restoration faults. No time should be lost in waiting for the disappearance of a suspected precancerous lesion after the elimination of the irritation. One must also remember that a cancerous lesion may have a considerable area of inflammatory reaction about it, and this associated inflammatory condition may subside after removal of the irritation and thus lead the dentist and patient into a sense of false security.

Lesions, therefore, should be watched carefully and observed frequently, and should they not progressively improve and disappear in the course of two or three weeks, appropriate treatment should be instituted.

Cancer is usually considered to include all malignant tumors of epithelial, connective tissue or special origin. Epithelioma or carcinoma implies malignancy of epithelial origin, and, in this group, we find practically all of the commonly occurring malignant tumors of the mouth and lips. Sarcomas and special tumors, such as melanomas and endotheliomas, are somewhat rare and we need not devote much time to their consideration.

Though the cause of malignant growths remains very much a mystery, the research of the past thirty years has furnished such a large amount of accurate and valuable information that we may expect greater results of the research labors of the future. The fact that malignant tumors occur in all forms of animal life, at least down to the reptiles, and also in fish, makes it unnecessary, in searching for the cause, to waste any more time in examining habits and customs peculiar to man, except as far as these involve chronic irritation. Heredity, once considered of great importance, then discredited for a time, has again assumed a prominent place as a factor, owing to a vast amount of research into the incidence of cancer in rodents and other animals. Just how far these spectacular findings can be applied to heredity and its relation to human cancer is a matter of considerable difference of opinion. The individual with a family history of cancer should most certainly keep his mouth in the best possible condition and should give prompt attention to any irritation that may develop. Tobacco must be used with care, and should be discontinued if oral irritation develops and persists. By such care, the hereditarily susceptible person can most surely avoid the development of cancer of the mouth. No such opportunity or assurance can be offered him concerning cancer in other parts of the body.

Woglom[1] says, "Three decades ago it seemed that we should have to explain why sarcoma was more common in youth and carcinoma in advanced life; in other words, why the same process should attack connective tissues when they were young and epithelium when it was old. Today, it is known that sarcoma, like carcinoma, becomes more frequent the greater the burden of the years, and it is strongly suspected that age in itself may really have nothing to do with the inception of malignant disease save in that long life means an extended period throughout

1. Woglum, W. H.: Experimental Study of Cancer, Am. J. Cancer, 15:12-14 (Jan.) 1931.

which the action of an irritant can be exerted.

"Instead of looking for one cause of cancer, therefore, we are beginning to realize that there may be many causes, and are patiently searching out clues and following them up as they appear."

The events that lead up to and actually excite the normal cell to overthrow its normal growth influences and control, to run wild, proliferate and invade surrounding tissues, to form a tumor that eventually will kill the patient if not itself destroyed are still unsolved. More intensive studies are being made of the live cancer cell in its fresh unfixed state as well as when fixed and stained. Practically all of the carcinomas in or about the mouth are of the squamous-cell variety, arising from the stratum germinatum.

Fresh malignant cells differ from the normal reparative regenerative cell in that the cancer cells have larger nucleoli and larger, coarser granules in the nucleus and are less delicate cells.

In the matter of prognosis, several facts are taken into consideration. These seem to influence the relation of the new growth to longevity. They are size of the growth, cellular character of the growth, age of the host, duration of the lesion, relation of growth to nutrition, relation of emaciation and obstruction of food intake, proximity to vital structures, lymph gland involvement and regional and distant metastasis. After excision of the tumor, four other findings on the microscopic examination of the tissue may favorably influence the prognosis. These are lymphocytic infiltration, fibrosis, hyalinization and differentiation of the tumor cells.

Cancer, once developed, invariably progresses to a fatal termination, unless it is arrested by surgery or some destructive method. The methods offering the best results are surgery, including destruction by cautery and diathermy, and radium therapy employed alone or in combination.

CANCER OF THE LIP

In epithelioma of the lip, one of the most frequent forms of cancer of the head, the patient and the surgeon are afforded the best opportunity for complete eradication of the disease. In no other region does one have the opportunity to so readily observe the development and course of precancerous lesions, as well as the onset of the carcinomatous process. Persistent lip cracks and fissures should be looked on with suspicion and excised when necessary. Ulcers may develop when sharp or broken-down teeth or dentures persistently cut into the lip or the traumatized area becomes thickened and shows keratosis. In some persons, the sun's rays produce inflammatory lesions of the lower lip, resulting in keratosis and ultimately carcinoma. Smoking may repeatedly irritate or burn the lip to form blisters or thickened areas that peel off, apparently heal and then recur. Tobacco burns may also produce a small depressed, dark area at the mucocutaneous margin. The surface is somewhat thickened and leathery in consistency but cannot be readily removed as a scab. After a few months, the lesion may become further heaped up, and separate, to be pulled off, leaving a shallow depression or at times an ulcer. Instead of healing up, the condition may recur and lead to carcinoma.

Seborrheic keratosis is a chronic form of irritation and thickening that may involve the major portion of the vermilion surface of the lips. Persisting for years, it may ultimately take on epitheliomatous changes. Leukoplakia may involve the lip, producing white or grayish white,

slightly raised patches upon the vermilion border. It may also be associated with other of the precancerous lesions.

Warts and papillomas are not uncommon and may be present for years. Irritation from traumatism, infection, cauterization or incomplete removal may be factors in their undergoing malignant change.

Any of the conditions mentioned may be aggravated by the contact of bacteria laden saliva from an unclean mouth.

The nature of the precancerous lesions in 602 cases is tabulated in a report on cancer of the lip by Janet E. Lane-Claypon,[2] M. D., D. Sc., Ministry of Health, London, as follows: scab, 27; bleb or ulcer, 384; wart or warty growth, 27; nodule or thickening, 74; fissure or crack, 55; site of previous injury, 11; leukoplakia, 24.

Little comment is needed. The commonest form of lesion seems to be either a bleb or an ulcer, actually probably an ulcer, and Broders, the latest of the authors quoted, found twenty instances of leukoplakia. It is probable that the older writers did not look for leukoplakia patches because the importance of leukoplakia in cancer was not appreciated. It seems, therefore, that leukoplakia is present as a factor in the development of cancer of the lip in approximately 6 per cent of cases. Bloodgood[3] has emphasized the importance of giving immediate attention to every irritative lesion of the lower lip. The teeth should be cleaned and any sharp irregular or ragged tooth margins irritating the lip should be ground smooth or restored, or the offending tooth removed. Vincent's stomatitis, if present, should be treated and eliminated. Tobacco in all forms should be discontinued. The lesion itself should be cleansed and touched lightly with medicated alcohol or spirits of camphor. It may then be wiped gently with a solution of sodium bicarbonate, dried and protected by a covering of vaselin or yellow mercuric oxid ointment. It is convenient for the patient to procure an ophthalmic tube of yellow mercuric oxid ointment, 2 per cent, using this to cover the area every few hours. The habit of biting the lip must be studiously avoided. If the lesion does not heal within three or four weeks, early carcinoma must be suspected, and the removal of the lesion for microscopic examination should be undertaken.

The onset of malignant change in a precancerous lesion of the lip is most insidious. After a few months, the patient comes to realize that the lesion has persisted longer than usual or has increased in size and become more firm. His suspicion is aroused by the fact that the lesion has not disappeared and healed as it had on previous occasions. Epithelioma of the lip may present considerable anatomic and clinical variation, but, usually occurs in two general types: (1) papillary and (2) ulcerative infiltrating. The papillary form tends to project from the level of the lip and the invasion of the deeper tissues and lymph channels is delayed. Tumors of this type grow more slowly and give a much better prognosis than the infiltrating types. These vary widely in appearance, extent and degree of infiltration. The dentist is not so much concerned with the advanced lesion, but rather is interested in the opportunity offered him to be of service to his patients in advising them to secure appropriate treatment while there is still hope of cure,

2. Lane-Claypon, Janet E.: Cancer of Lips, Tongue and Skin, Reports on Public Health and Medical Subjects, No. 59.

3. Bloodgood, J. C.; in Practice of Surgery (editor, Dean Lewis), Hagerstown, Md.: W. F. Prior, Inc., 1928.

and particularly before metastases have taken place to the glands of the neck.

About half of the patients suffering from cancer of the lip come in for treatment within one year of the alleged onset of symptoms. This average period of time does not include the duration of the preceding precancerous lesions. Untreated, cancer of the lip may have a slow course and extend over several years. Three stages of the condition are recognized: (1) early cases, apparently local without palpable glands (the majority of cases); (2) cases with palpable glands; (3) advanced cases, involving the bony substance of the mandible. As time goes on and our efforts are successful, practically all of the cases not seen as precancerous lesions should fall into Class 1. It might be noted that carcinoma of the lip may occur in quite young persons. It is nineteen times more common in the lower lip and affects men fourteen times more often than women. (Fig. 2.)

For several years past, most surgical pathologists have come to grade epitheliomas of the lip according to the degree of differentiation of the malignant cells as demonstrated by Broders.[4] This has had an influence on the type of treatment, for the most malignant and least well differentiated grade 4 cases are the most sensitive to radium therapy, while the most differentiated cases are more resistant to radium and respond to surgery.

The surgical excision of a carcinoma of the lip and the removal of the glands has been a long established and reasonably successful procedure, resulting in a five-year survival rate of from 60 to 80 per cent, according to the duration and extent of the lesions before operation. Any improvement in this mortality rate must come from earlier recognition of the character of the lip lesion, and in this the dentist may play no small part. Radiotherapy, advancing in efficiency year by year, can claim a survival rate for three years of 76 per cent for all stages of the disease (90 per cent of recurrences develop within 3 years). It would seem probable that roentgen irradiation and radium therapy, when properly safeguarded and the dosage carefully calculated, may supplant surgery in the treatment of this condition.[5] There will no doubt be many cases in which surgery, diathermy, roentgen irradiation and radium therapy in combination may be indicated. In cases treated by heavy external irradiation of the neck rather than by surgical excision of the gland-bearing tissues, there rests a special responsibility on the surgeon or hospital to maintain a well-organized routine follow-up system. Too many patients do not realize the seriousness of their lip lesions and soon forget that the small "sore" that healed so nicely under radiotherapy was really cancer. They must be so impressed with the importance of the follow-up examination that they will make sure that nothing will prevent their returning for examination at yearly intervals.

Group 3 cases with bone involvement usually require diathermy or cautery excision, radiotherapy and plastic surgery. Such do not come within the field of observation of the dentist except when he is called on to cooperate in the treatment. From a dental standpoint, it is of interest that, in recurrent cancer of the lip, the mandible may become involved centrally

4. Broders, A. C.: Carcinoma of Mouth—Types and Degrees of Malignancy, Am. J. Roentgenol. & Rad. Therap., 17:90-93 (Jan.) 1927.

5. Quick, Douglas: Special Clinic on Epithelium of Lip, Am. J. Cancer, 15:223-270 (Jan.) 1931.

by extension through the mental foramen without any appreciable invasion of the periosteum.

Other growths and tumors of the lip are benign cysts of the muciparous glands: hemangioma, endothelioma and lymphangioma. Mixed tumors of the lip are uncommon and are similar to those of the salivary gland regions. They are slow-growing tumors, enlarging gradually over a long period of years to form a circumscribed firm tumor surrounded by a definite capsule. Sarcoma is also rare, and, like mixed tumors, develops within the substance of the lip, producing marked enlargement. It may appear just beneath the mucous membrane. Unlike carcinoma, the surface involvement is secondary to the deeper tumor development. Sarcoma may simulate abcess, phlegmon or the lesions of primary syphilis.

CANCER OF THE ORAL MUCOUS MEMBRANE

In cancer of the oral mucous membrane, cheek, floor of the mouth, tongue and palate, the prognosis is not nearly so favorable as in cancer of the lip. The condition is much more rapid in its course and metastases occur at an earlier stage to the regional and more deeply situated cervical glands. The precancerous lesions may not be so noticeable if pain is absent. Leukoplakia is of much greater importance in cancer within the oral cavity. Any signs of added thickening, fissuring, cracking, heaping up or desquamation to produce an ulcer should be looked on as an epitheliomatous change, and biopsy should be made to determine the treatment indicated. Leukoplakia should be watched carefully. Contributing causes, such as the use of tobacco, oral sepsis, traumatism or syphilis should be eliminated. The treatment of leukoplakia has been notably unsatisfactory. There is a consensus of opinion that, in most cases, this lesion can be improved by careful attention to cleanliness and the avoidance of further irritation. Administration of magnesium sulphate in 15 grain doses three times daily for two months has resulted in marked reduction of the lesions, according to Berven in the 1929 report of *Radiumhemmet*. At the conclusion of the magnesium sulphate treatment, any remaining suspicious area of leukoplakia is coagulated with endothermy, using a flat electrode. Other authorities recommend alkaline mouth washes and protective ointments. The exact percentage relationship of leukoplakia to syphilis, the use of tobacco and oral sepsis, and the percentage of cases subsequently becoming carcinomatous, may never be determined. Bloodgood stresses the importance of leukoplakia of the mucous membrane of the alveolar process and gingiva as a forerunner of cancer.

Many more benign lesions are presented for treatment than was formerly the case, and the problem of treatment has been thereby changed in the direction of prevention of carcinoma by adequate attention to the precancerous lesion. Bloodgood states:

> The chief danger today is that a patient with a lesion of the mouth which is not cancer and which will disappear of itself if the causative factor or factors, tobacco, ragged, dirty teeth, ill-fitting plates, Vincent's infection, infected tonsils are removed, may receive radium treatment instead of the removal of the causes and suffer from a burn which takes time and patience to heal. The percentage of these cases in the last five years is on the increase.

Such a statement by this authority should impress the dentist concerning his responsibility and opportunity.

Cancer of the mucous membrane of the cheek is notably virulent, with widespread local involvement of the lymphatics and early metastasis to the cervical glands. Formerly, most of the patients were first seen in a late and hopeless stage of the disease. In recent years, the effect of cancer propaganda is being evidenced by patients presenting themselves in the early stages of the cancerous process. Dentists must be ever watchful for such conditions. Bloodgood states:

> Cancer of the cheek demonstrates better than cancer in any other locality in the mouth the importance of prevention; cleansing and smoothing of the teeth. Attention at once to any type of irritation by stopping tobacco in all forms and immediate and proper excision with the cautery, of all local lesions which have passed the stage of cure by the removal of the cause, — teeth, ill-fitting plates, tobacco.

Dentures should not be permitted to produce areas of irritation of the alveolar process and cheeks. This is not sufficiently emphasized in the teaching of prosthetic dentistry, nor are patients impressed with the necessity of having periodic service, relinings and remaking, in order to maintain comfortable, efficient and non-irritating dentures. Bloodgood claims that the presence of ill-fitting plates has been responsible for more cancers in the mouth without the aid of tobacco than any other condition.

Cancer of the cheek may be treated by surgical diathermy, excision, radium therapy, roentgen irradiation with removal or irradiation of the gland-bearing areas of the neck.

Cancer of the floor of the mouth is of serious import, particularly when located in the posterior area. Destruction of the growth by diathermy or cautery coagulation, with or without radium and roentgen irradiation, is the treatment of choice of many experienced surgeons.

The hard and soft palate may be the site of a large variety of tumors, both benign and malignant. Secondarily, the palate may be involved by tumors arising in the nose, antrum, alveolar process or pharynx.

Benign tumors of the palate, which are relatively infrequent, include papilloma, angioma, fibroma, osteoma, lipoma, mixed tumors and adenoma. These tumors present characteristics similar to those of growths occurring in other parts of the body. Inspection and palpation, with the history of the onset and rapidity of growth, will usually reveal their exact nature and the fact that they are benign. Their relative vascularity will determine the best mode of treatment, which is either surgical excision or removal by cautery. In general, these tumors are well capsulated and, when small, can be well removed under local anesthesia. Large tumors are often firmly attached to the bone, and may best be removed under general anesthesia to permit cauterization of the bone after the excision. Mixed tumors of the palate, when large, show a tendency to perforate the capsule, and, after doing so, may undergo a change in character to a malignant epithelioma. Melanomas (melano-epitheliomas) occur on the hard and soft palate. They tend to grow rapidly and are usually very malignant. The diagnosis is made by the pigmentation and by biopsy. Treatment must be radical.

LESIONS OF THE TONGUE

The tongue may be the site of a great variety of lesions, areas of irritation, ulceration of various forms, benign tumors, including fibromas, warts and papillomas, vascular tumors, tuberculosis, syphilitic lesions, hypertrophy of the papilla, cysts, carcinoma and sarcoma. The varied clinical pictures of many of these condi-

tions present considerable difficulty in the diagnosis. Careful examinations must be made in order that no valuable time be lost should the condition be an obscure carcinoma; for the ultimate cure of this condition is largely dependent on early diagnosis and energetic treatment.

Ulcerations of the tongue should be examined with a view to determining the general appearance, including depth, condition of the edges, induration, pain and chronicity. Traumatic ulcers have an obviously local cause, such as the presence of a sharp carious tooth or defective dental restorations. Elimination of trauma and oral sepsis results in prompt healing. It must be remembered that a traumatic ulcer may occasionally become infected by tubercle bacilli and Vincent's organisms. The tuberculous ulcer is usually shallow, of granular surface with irregular margins. It is usually painful and tender and extends gradually.

Syphilitic ulcers of the tongue are more frequent in the posterior portion and are, as a rule, deeper and present a more punched-out, ragged appearance, with little induration. The Wassermann reaction is positive in about 80 per cent of cases, and the therapeutic test of the administration of arsphenamin is usually conclusive. The coexistence of syphilis and tuberculosis must be kept in mind. The primary lesion of syphilis is more indurated, is usually raised and is of short duration.

A carcinomatous ulcer is usually solitary and deeper, presenting irregular raised everted edges with marked induration. It is frequently associated with leukoplakia. Tuberculosis of the mouth and carcinoma occur at the same age, in the same locations and in the same sex. (This similarity is not generally known.) Epithelioma of the tongue must be diagnosed promptly to afford chance of cure.

The ulcerative lesions of ulcerative stomatitis, herpetic stomatitis, Vincent's stomatitis, erythema multiforme and foot and mouth disease will rarely be confused with cancer on account of the acuteness of their onset, more rapid course, earlier glandular involvement and associated systemic or cutaneous symptoms.

Carcinoma of the tongue usually is of rapid growth, and, if untreated, usually has an actual duration of about sixteen months before death occurs. Statistics of a very large group of cases would seem to show that about one half of this time has elapsed before the average patient has sought treatment. These statistics, of course, extend many years back, and it would seem that patients are now seeking advice regarding tongue lesions at a much earlier date. There is necessary the dissemination of more widespread information regarding all lesions of the tongue that may eventually undergo carcinomatous change. In this, the dentist should play no small part.

The mortality of carcinoma of the tongue is very high. Massed statistics seem to show that but from 20 to 25 per cent of patients are alive three years after treatment. At five years, this percentage is materially reduced. In England, the mean age at death from cancer of the tongue is 61 years, which is nine years less than the corresponding figure for cancer of the lip. Cancer of the tongue occurs in practically all portions, having a predilection for the border, from the tip to the base. The surface may be raised or depressed and ulcerated. In general, the tumors situated anteriorly are firmer and show more differentiation than those situated posteriorly. For this reason, in many clinics, anterior tumors are re-

moved by surgical or diathermy excision and posterior tumors are treated by radium, sometimes later followed by destruction by coagulation. In other clinics, excision is not attempted, reliance being placed on radium alone, or the use of radium followed by coagulation by diathermy. It would seem that distinctive advances have been made with reference to the lesion of the tongue, but the treatment of metastases to the neck remains a great problem. Extensive block dissections of the neck have not always prevented recurrence, nor has the use of radium externally or implanted as emanations within the glands been uniformly successful. The same may be said of roentgen irradiation. Dr. Blair, of St. Louis, has some very interesting cases of complete excision of the tongue and floor of the mouth and removal of the glands. This extreme method is not being generally adopted.

It must be emphasized how serious this condition is and how dentists must pay careful attention to modern dental principles and make sure that no irritation can arise that might be of dental origin. Furthermore, they must be ever conscious of the necessity of prompt and continued observation of any unusual-appearing lesion of the tongue. What has been said about the correction of all dental faults, such as sharp cavity margins and worn edges of enamel, inlays, crowns and clasps, is more particularly necessary in the case of traumatisms of the tongue. After the correction of these faults, lesions of the tongue should clear up. If they do not, further search should be made for evidence of Vincent's infection or reinfection of the area from the more commonly seen condition of pyorrhea. If the tongue lesion persists, biopsy is usually indicated.

CARCINOMA OF THE MANDIBLE AND MAXILLA

Carcinoma developing in the gingival region to involve the bony substance of the mandible or maxilla is the one form of intra-oral cancer that demands of the dentist a thorough knowledge of its different manifestations and varied clinical course. Far too frequently, a dentist continues to treat, without suspecting its nature, one of these tumors, with a mistaken diagnosis of delayed healing of an extraction socket, infection or osteitis. Much precious time may be lost, and at times spread of the malignancy may be initiated, by untimely dental interference such as curettage of the affected area.

These are epidermoid carcinomas arising from the regenerative layers of the protective epithelium of the mouth and are seen in two definite clinical forms, papillary and infiltrating, though they may occur in a combined form. Papillary carcinomas of the jaws may so resemble certain varieties of the so-called epulis that diagnosis is often impossible before operation and histologic section. They usually develop slowly and project into the mouth cavity from the surface of the jaw in the gingival region. At times, a bulky tumor may be produced. Involvement of the periosteum usually occurs later, and metastasis to the regional lymph nodes is delayed or may not occur. Excision of the tumor and underlying periosteum, preferably with the actual cautery, or destruction by diathermy will usually result in complete cure.

Infiltrating carcinoma presents a wide variety of clinical manifestations that should be well known to members of the dental profession. Occasionally, an infiltrating cancer may show papillary projection into the mouth. The history is usually of rapid development of the mass.

oftentimes with recurrent bleeding from its surface. Roentgen-ray examination will reveal the irregular progressive destruction of the underlying alveolar process.

The erosive infiltrating type of carcinoma presents an extensive but shallow destruction of the bony surface of the jaw. There is rarely any projecting tumor within the mouth, but rather a patch of leukoplakia on the alveolar process which presents a depression, crack or shallow ulceration. When such changes occur, little difficulty should be experienced by the dentist in making a probable diagnosis.

The more deeply infiltrating types are more treacherous and difficult to diagnose. A long-standing patch of leukoplakia may shed its white, thickened surface over a small area and present a congested, softened spot. The extra-oral film reveals deep infiltration and destruction of the bony substance of the mandible, necessitating complete excision from the symphysis to the ascending ramus.

The infiltrating forms of carcinoma that are associated with extraction wounds are of especial interest to the dentist. Usually, the cancerous process is established before extraction of the tooth, and has, by beginning infiltration, led to slight loosening and soreness, thus bringing the patient to the dentist for relief. Simple extraction is readily performed and no suspicion of carcinoma enters the mind of the dentist. To diagnose an early case of this type is consequently extremely difficult. Routine drying out of extraction sockets and careful visual examination would in many cases show the dentist that some unusual tissue proliferation was present.

A preoperative dental film of lesions of dental periclasia in the early stages is rarely diagnostic. When unusual-appearing tissue is found in a socket and removed, it should not be thrown away, but should be preserved in formalin, 10 per cent solution, for sectioning, if necessary. Tooth sockets affected by carcinoma rarely heal. The tumor cells may extend deeply into the jaw, in which case repeated dental roentgen-ray films will practically clear up the diagnosis. In other cases, the margins of the socket will show ulceration and enlargement, with perhaps an associated patch of leukoplakia, and the dental film will reveal the deeper destruction of bone. Unfortunately, many of these sockets are repeatedly curetted for dead bone, granulation tissue, etc., and much valuable time is lost.

Rarely, the history of local traumatism and irritation will be suggestive and tooth extraction may be followed by apparent complete healing of the socket. Deep infiltration of the carcinomatous cells will continue, with complete absence of surface manifestations. When such a condition is associated with signs of a nonsuppurative, acute or subacute inflammation of the region, diagnosis is still more difficult for a time.

A MISLEADING TYPE

The suppurative infiltrating type of carcinoma of the jaws is most misleading. The history of irritation and appearance of the teeth and sockets at extraction may be like that of the types already discussed, but there rapidly ensues a condition of marked suppuration with tumor extension. Osteitis and necrosis of bone from both tumor invasion and infection supervenes, and a diagnosis of osteoperiostitis (osteomyelitis) delays the application of effective treatment.

The mortality of infiltrating carci-

noma of the jaws is high, owing largely to the usual delay in consultation and correct diagnosis. The dental profession can accomplish a great deal toward improving the prognosis.

The treatment depends on the extent of the lesion, involvement of regional glands, etc. In the mandible, superficial lesions may be treated by heavy electric cauterization or surgical diathermy. Adjoining teeth that may be affected should be removed and the sockets cauterized, enlarged and again cauterized. This is followed by the formation and separation of a sequestrum in four to twelve weeks' time, following which the parts usually become thoroughly healed.

In deeper involvement, excision of a section of the mandible is indicated. Should the tumor involve the mandibular canal, the entire mandible should be excised from a point 2 or 3 cm. anterior to the lesion, back to the articulation. With this excision, the upper cervical, submaxillary and submental lymph nodes, gether with the submaxillary gland, should be removed.

Radium or deep roentgen-ray therapy of the local area may be indicated both before and after operative procedure.

Carcinomas involving the alveolar process of the upper jaw, if superficial, may be treated by cauterization, etc., as for the mandible. When more deeply situated and anterior, the excision must be carried through to the floor of the nose. When situated distally, the excision may involve a greater or less area of the floor of the maxillary sinus, with or without the removal of the tuberosity.

Cancer of the upper jaw beginning within the maxillary sinus is still more treacherous. Most cases so occurring are diagnosed too late for hope of cure. Symptoms may simulate sinusitis, and conservative antral treatment or more radical antral exposure without biopsy may continue the incorrect diagnosis for a long period of time. Dentists should be alert to the possibility of carcinoma developing within the maxillary sinus. Often, the symptoms complained of are discomfort or pain in the teeth or in the alveolar process, or, at times, in edentulous cases, the patients and dentists feel that an artificial denture is at fault, and relining or new dentures may be made without relief of the symptoms of pain or pressure. Finally, nasal symptoms or perhaps involvement of the orbit and displacement of the eyeball may make the diagnosis of tumor involvement positive. I have seen patients go back and forth between nose and throat specialists and dentists for several months, until the extension of the tumor through the alveolar process into the mouth or through the sinus wall into the nasal cavity established the diagnosis of carcinoma.

This survey of malignant tumors involving the mandible and maxilla shows the difficulties of early diagnosis in many cases. It emphasizes that eternal vigilance on the part of the dental profession is necessary in order to prevent the development of carcinoma and to diagnose cases in their early stages. By so doing, we may look forward to a time when deaths from carcinoma beginning on the oral surfaces shall be of rare occurrence.

RELATION OF ARTHRITIS TO DENTAL INFECTION*

By PHILIP LEWIN, M.D., F.A.C.S., Chicago, Ill.

THE title of this paper might be "Orthopedic Observations on Arthritis in Relation to Dental Infection."

From an experience of about twenty years, certain facts have become crystallized in my mind, and it is from the practical standpoint that I wish to discuss this problem. My position in this matter is that of an orthopedic surgeon who sees a large number of patients with arthritis and other rheumatic conditions. In most of these cases, infection plays or has played an important part.

This paper includes a discussion of the broad subject of arthritis with special consideration of its relation to dental infection. Pathologic dental conditions and systemic disease are reciprocal processes. The condition of the tooth affects the system and the systemic condition affects the tooth. I shall discuss the interrelationship of foci of infection such as occurs in tonsils, teeth and genito-urinary, gastro-intestinal and respiratory tracts.

DEFINITION OF ARTHRITIS

Arthritis is a condition affecting bones and joints. It may have many causes, including infection, injury, exposure and metabolic and circulatory disturbances. It is manifested by pain, tenderness, limitation of motion, sensitiveness to motion, tenderness to touch, swelling and, in some cases, redness. Deformity or disability, or both, may result. The pathologic changes are proliferative and degenerative. The treatment includes local, focal and general considerations.

ARTHRITIS VS. RHEUMATISM

The terms "rheumatism" and "arthritis" are not synonymous. Rheumatism is the all-inclusive term. When rheumatism affects the bones and joints, it is called arthritis. When it affects the nerve, it is neuritis. When it affects muscle, it is myositis. When it affects fibrous tissue, it is fibrositis, and similarly we use the terms capsulitis, ligamentitis, fascitis and myofascitis. They are all part and parcel of the same condition, called rheumatism.

HISTORICAL ASPECTS

Historically, rheumatism is probably the pathologic condition of oldest known or proven record. It is said that it occurred in prehistoric man and in the earliest representative of the present species known as man. Arthritis was present among the early Egyptians, as evidenced by the specimens in the Field Columbian Museum which reveal high-grade osteoarthritis of the spine and other bones. Jones calls attention to the splendid teeth of the Nubians, and the great prevalence of osteoarthritis among them.

ECONOMIC ASPECTS

The economic aspects of arthritis and the rheumatic conditions are very impor-

*Read before the Section on Research and Biologic Sciences at the Midwinter Clinic of the Chicago Dental Society, Jan. 20, 1932.

tant. This is illustrated by the fact that in England in one year about $85,000,000 was expended because of rheumatic disabilities. Rheumatic disease is a drag on industry and a source of heavy financial loss to the state.

TABLE 1. — ETIOLOGIC FACTORS IN CONDITIONS AFFECTING BONE AND JOINT STRUCTURES

- Infection
  - Local
  - Focal
- Trauma
  - Without infection
  - Plus infection
- Toxins:
  - Organic
    - Bacterial
    - Chemical
    - Tobacco
    - Drugs
  - Inorganic
    - Alcohol
    - Lead
    - Sugar
- Circulatory disturbances
  - Arteriosclerosis
  - Embolism
  - Hemorrhage
- Nutritional disturbances
- Mechanical strain
  - Knock knees
  - Bow legs
  - Flat feet
  - Weak musculature—poor posture
  - Weak ligamentous support
  - Loose bodies in joints
- Endocrine disturbances, especially thyroid and gonad
- Nervous system disturbances
  - Central nervous system
    - Charcot's disease
    - Syringomyelia
    - Cord tumors
    - Peripheral nerve lesions
    - Brain tumor
    - Encephalitis
  - Sympathetic nervous system
- Allergic factors
  - Bacterial
    - Living
    - Dead
  - Chemical
    - Food
    - Plants
    - Animals
  - Physical
    - Heat
    - Cold
    - Moisture
- Climatic conditions
- Congenital defects
  - Bones of extremities
  - Spine
- Neoplasms

CLASSIFICATION

Many classifications of arthritis have been proposed. None has been universally accepted. Some prefer to use the terms "acute," "subacute" and "chronic"; others use the terms "atrophic" and "hypertrophic"; still others, "proliferative" and "degenerative." Other writers prefer to use an etiologic classification depending on the causative organism.

For practical purposes, a simple classification is: infectious, metabolic and mixed.

PATHOLOGY

Most writers agree to accept the classification of Nichols and Richardson proposed in 1909, which is based on the pathologic changes involved in the disease, considered under the two main headings of proliferative and degenerative. Synonymous with proliferative is atrophic or infectious; synonymous with degenerative is hypertrophic or osteoarthritic.

ETIOLOGY

The etiologic factors in arthritis are given in Table 1.

The causes of arthritis can be summarized as including infectious, metabolic, traumatic and miscellaneous conditions. The miscellaneous factors may be listed as follows:

Heredity
Age
Sex
Color
Occupation
Endocrine disturbances
Autointoxication: metabolic disturbances, visceroptosis, diet, pregnancy
Poisons: alcohol, tobacco, lead
Circulatory disturbances: arteriosclerosis, embolism
Nutritional disturbances
Nervous system disturbances: central nervous system, sympathetic nerve disturbances
Mechanical disturbances: knock knee, bow legs, flat foot, poor posture
Climate, geography
Allergy, anaphylaxis
Exposure to extremes of temperature and moisture

TABLE 2.—CLASSIFICATION OF ORGANS IN RELATION TO CLAVICLE

- Clavicle
  - Above
    - Teeth
    - Throat
    - Sinuses
    - Ear
    - Skin
    - Lymph glands
    - Thyroid
  - Below
    - Bronchi
    - Lungs
    - Glands
      - Mediastinal
      - Retroperitoneal
    - Heart
    - Gastro-intestinal tract
      - Stomach
      - Intestines
      - Lymph glands
      - Gallbladder
      - Appendix
      - Diverticula
      - Liver
    - Genito-urinary tract
      - Kidney
      - Bladder
      - Urethra
      - Tubes
      - Vesicles
      - Prostate
    - Skin

The causes of arthritis may be conditions or agents which operate from within or without the body. If the cause is an infection, the body may be divided for discussion into two parts, that above and that below the clavicle, as shown in Table 2.

Dental conditions may cause any type of rheumatism and in any location, but are especially prone to produce what is known as brachial neuritis, i. e., nerve pain in the neck traveling down the shoulder and arm into the hand.

TRAUMA

Trauma means injury. Every movement of a joint causes trauma. If the circulation is good, the effects of the trauma are repaired immediately. If repair does not progress so rapidly as destruction, a pathologic condition results. If circulation is impaired, the defect is not repaired and an area of pathologic change is formed. The joints most liable to trauma are those of the feet, the fingers, the wrist, the knee, the shoulder, the elbow and the hip.

Trauma may be acute or continued. Acute trauma may be mild or severe. Continued trauma may be mild or severe. As an example of mild, continued trauma, one should consider the activity of the pianist and the ballet dancer. Under severe continued trauma, one may consider the work of the iceman, the plumber, the piano mover and other persons who carry heavy objects.

In a discussion of trauma, one may consider trauma as the only factor, trauma as the precipitating factor and trauma which exaggerates a preexisting condition. As an example of trauma as the only factor, one may consider fractures of the os calcis in a perfectly normal healthy person; as an example of trauma as a precipitating factor, the case of an overweight woman of 50 years who has asymptomatic arthritis in both knees. She falls and injures one knee, and an arthritis flares up. As an example of trauma exaggerating a preexisting condition, one may consider the case of a knee joint which has a low-grade arthritic condition that is affected by changes of weather, but is perfectly serviceable until the woman falls on the sidewalk and bumps her knee, with resultant pain, swelling and disability.

The menopause lowers the resistance just as does an attack of influenza.

SYMPTOMS

The chief symptoms of arthritis are pain, stiffness, swelling, crepitus, limitation of motion, fatigue, atrophy and deformity. The pain may be local or referred. The stiffness is most commonly complained of on resumption of activity after a period of rest. Swelling is due to the exudate of the joint. It is most commonly due to the synovitis.

Crepitus, or creaking of the joint, may be palpable or audible. It may be fine or coarse. Limitation of movement is due to pain, stiffness, swelling or a combination of two or more of these. As regards weather, there are two types of arthritics; those who dread cold weather and those who dread hot weather. It is probably a sympathetic nerve reaction. Fatigue is the symptom complained of by most patients with arthritis, especially of the infectious type. The fatigue is due to the fact that the patient is tired from fighting the disease. Atrophy may be present in both types of arthritis, but especially in the infectious or atrophic type. It is probably due to a combination of conditions including nonuse and neurotrophic influences. Deformity may range between

the two extremes of practically no deformity and severe crippling.

PHYSICAL FINDINGS

The physical findings include chiefly swelling, atrophy and deformity. The swelling is due to synovitis, i. e., to the presence of the exudate, and to the exostoses. The atrophy has been discussed under symptoms. The deformities may range from practically none to the extreme degree found in arthritis deformans. Several examples of deformity may be given here, including Heberden's nodes, which occur at the distal interphalangeal joints of the fingers. They were described in a classical manner by Heberden more than 125 years ago. Heberden's nodes are most commonly seen in women, especially those who do much manual work such as sewing or knitting. At the proximal interphalangeal joint may be found a type of deformity known as Haygarth's nodosity, which is spindle-shaped.

Other deformities of the fingers include hyperflexion and hyperextension of joints. Usually, the interphalangeal joint is hyperextended and the distal joint flexed. Ulnar deviation of the finger is very common and is probably due to the position that the hand assumes while the patient is bed-ridden.

The deformity at the wrist is usually palmar flexion; at the elbow, a flexion deformity; at the shoulder, an adduction and internal rotation deformity. Deformity in the neck is usually forward flexion. Deformity of the spine is usually of one of two types: a flexion deformity which causes a severe round kyphosis with or without flattening of the lumbar spine; or a complete straight stiff spine with obliteration of the thoracic and lumbar curves.

Deformity of the hip is usually flexion and adduction. Deformity of the knee is usually flexion. Deformity of the foot is plantar flexion and valgus at the midtarsal joint. Deformities of the foot include flat foot, pes cavus and clawtoes with contracture of the extensor tendons, many of which are accompanied by or due to actual dorsal dislocation at the metatarsophalangeal joints. This occurs most commonly in the four outer toes, the great toe usually developing an exostosis or hallux valgus.

Disability means inability of the limb or member of the patient to perform the ordinary acts or movements under ordinary circumstances that are considered normal. Disability may be evidenced by weakness of part or all of a member or organ in performing its normal function under normal conditions. In the movement of any extremity, the two most important factors are the power, or the amount of force, present and the range of motion. The former is indicative of function present in the muscles crossing the joint and the latter of the amount of motion between the joint surfaces.

Crepitus is practically always palpable to the touch, and may be audible. It may vary from practically nothing to an extreme degree in which it can be felt very readily and can be heard easily. I have seen patients with crepitus of the knee so marked that it could be heard across an ordinary examining room.

ROENTGEN-RAY FINDINGS

The interpretation of the roentgenogram is an important and at times a difficult problem. One must know (1) what to look for; (2) what he sees, and (3) what it means.

The roentgen-ray findings in arthritis consist of two main types: the atrophic and the hypertrophic. Atrophic findings are illustrated by rarefaction or decalcifi-

cation of bone. Hypertrophic bone changes are illustrated by the exostoses or osteophytes which occur so commonly, especially in osteoarthritis of the knee joint.

The degenerative changes occur most commonly in the central portion of the cartilage of the bone; the proliferative changes, at the margins, where circulation is better. There may be atrophic, hypertrophic, a combination of atrophic and hypertrophic changes and destructive changes.

OTHER LABORATORY FINDINGS

Other laboratory findings may be divided into bacteriologic, cytologic and metabolic. Under bacteriologic are included findings in the examinations of the nose, sinuses, throat, teeth, sputum, urine, blood, feces, regional lymph glands and biopsy material. Cytologic examination includes the blood, feces and urine. Examination of the blood includes cytologic and chemical studies. Examination of the feces includes mechanical and bacteriologic factors. The perspiration is examined for acidity and alkalinity. Metabolism tests include the basal metabolic rate. Examination of the regional lymph glands includes bacteriologic studies. Biopsy includes gross, microscopic and bacteriologic examination.

DIAGNOSIS

The diagnosis of arthritis can usually be made upon the following: (1) a complete history; (2) a careful examination; (3) a roentgen-ray examination, properly interpreted, and (4) other laboratory tests. The history, physical examination and roentgenographic examination should establish the diagnosis of arthritis.

DIFFERENTIAL DIAGNOSIS

Under differential diagnosis, one should consider (1) the determination as to whether one is dealing with arthritis; (2) the differentiation of the type of arthritis, and (3) the differential diagnosis from other conditions. Included here will be mentioned various conditions the complete differential diagnosis of which cannot be entered into because of lack of time. These conditions include rheumatism, gout, neuritis, myositis, fibrositis, tendonitis, bursitis, osteomalacia, neuropathic joint conditions, such as Charcot's disease, and syringomyelia.

PROGNOSIS

Hench says that arthritis may be as inconsequential as gray hairs or more agonizing than death. The various factors in the prognosis include age, heredity and the general condition, duration of the condition, evidence of activity of the disease, the amount of atrophy present and treatment.

It is a general proposition that the younger the patient, the worse the prognosis. If the condition is hereditary, the prognosis is unfavorable. The general condition of the patient is very important. Evidence of activity of disease was formerly regarded as a bad prognostic omen, but I do not believe that it is. The greater the atrophy, the worse the prognosis. Naturally, the earlier the treatment, the better the prognosis.

COURSE

The course of arthritis is extremely variable. There may be recurrences, relapses, a stationary period or cure.

TREATMENT

The treatment of arthritis may be divided into three parts: (1) prophylactic, (2) remedial and (3) curative. Under curative may be mentioned (a) treatment of the disease; (b) treatment of the patient, and (c) treatment of the etiologic factors. Under prophylactic

treatment should be considered general treatment and orthopedic measures.

The patient is interested, not in what the roentgenograms or laboratory tests reveal, but in the discomfort, disability and deformity associated with the condition.

Under remedial treatment are included local treatment, focal treatment and general or constitutional treatment. Under local treatment are included heat obtained by various means, local applications, including liniments, lotions and contrast applications, traction on the joint, the use of a splint or cast, both supportive and corrective, and injection of the joint with substances such as olive oil or solution of formaldehyd and glycerin.

Focal treatment includes treatment of various foci such as the teeth, sinuses, tonsils, pelvis, intestines, gallbladder, appendix and skin. The general or constitutional treatment involves building up the resistance of the patient and maintaining his morale. In the treatment of every chronic disease, it is most important to get the patient in the proper frame of mind and improve his attitude toward his condition. This is illustrated by the change in theory regarding treatment of tuberculosis, whereby, after a long period of education, the patient comes to assume the proper attitude toward his condition.

Concerning the question of diet, there is considerable discussion. There are two main schools, one group believing that carbohydrates must be cut down or eliminated from the diet, the other that it is the animal proteins, such as meat, fish and eggs, which are harmful.

It would require a long time to go into the subject of diet. A few remarks are in order to the effect that in the atrophic person who has lost weight a diet which consists of large amounts of protein, such as the animal and the vegetable proteins is indicated. This individual needs ammunition to fight the disease; this ammunition is supplied by his food and should contain animal protein. The overweight person who has been eating too much most of his life and who has hypertrophic arthritis would do well to cut down on meat, fish, eggs, sweets and other carbohydrates to a very considerable degree. He should be on a reducing diet. The things which agree with one are apt to be taken to excess. Some clinicians go so far as to advocate giving the patient anything which agrees with him.

The hygiene of the arthritic patient is important.

Drugs may be considered as those given by mouth or by rectum, or given hypodermically or intravenously. I shall not discuss this phase of treatment except to say that probably a longer list of drugs is used in the treatment of arthritis than in any other condition. This in itself is an indication that there is no specific medicine for arthritis. The salicylate group has some foundation for its value in the treatment of arthritis because it has been proved that it increases capillary blood flow and this is a beneficial factor in arthritis. It is probably in this manner that it relieves pain.

The treatment of constipation or intestinal stasis is very important and may determine whether or not a patient will improve. I shall not enter into the subject of colonic irrigation except to say that in selected cases it is undoubtedly a valuable method.

I would recommend the use of compound licorice powder as a cathartic because it does not produce a watery stool. Furthermore, any solution used in colonic irrigation that dissolves organ-

isms is harmful in that toxic products get into the circulation. One should be against the practice of purging. In certain gallbladder disturbances, bile salts are of value.

VACCINE THERAPY

If it is true that arthritis is a bacteriologic problem, it follows that in its treatment this condition must have a bacteriologic factor, and probably the best means that we have at the present time is vaccine. Vaccines may be nonspecific or stock vaccines, specific or autogenous, which include those taken from foci of infection and regional lymph glands.

Among the numerous investigators and physicians using various types of vaccine are Burbank, Crowe, Cecil, Park, Rosenow, Gibson, Small and Gray, Wetherly and Clawson and Dawson and Boots. Since I have added to my routine treatment the use of Burbank and Crowe vaccine, very often in combination, I have been able to do more for my patients than I had been able to do without these two means of treatment. In the treatment by vaccines, there are a few general principles of value. One should maintain the dose that keeps the patient feeling well. The smaller the dose the better. In vaccine treatment, one is desensitizing and not immunizing the patient; therefore, small doses are advisable. The dose depends on the type of case and the reaction, which may be manifested by low blood pressure, low pulse rate, depression, mental and physical, somnolence or insomnia. In the use of vaccines, we want an early mild reaction, not because it does the patient good, but because it gives us information. Serums are not in general use in the treatment of arthritis.

An important aid in treatment is physical therapy, which includes thermotherapy, massage, hydrotherapy, mineral baths, mud baths, passive exercises, active exercises, including posture work, mechanotherapy, manipulation, passive congestion, electrotherapy, including electric light baths, diathermy, autocondensation and negative galvanism, colon therapy, heliotherapy, climatotherapy and marinotherapy. Hemotherapy includes blood transfusion, autoserotherapy and autohemotherapy.

Roentgenotherapy is a form of treatment that is not used so frequently as it should be. It is of definite value in relieving pain in many chronic arthritic conditions. Radium therapy is of value in some chronic arthritis cases. It is probable that radium emanations themselves are of value but the radium waters are not.

We now come to the orthopedic treatment of arthritis, which includes nonoperative and operative measures. The nonoperative treatment includes rest in bed, counterirritation, the use of heat, casts, including wedge casts, splints and braces, and forcible manipulations. The operative treatment may be divided into the bloodless and the open operation. The chief illustration of bloodless operation is forcible manipulation under anesthesia. Then open operations include osteotomy, tenotomy, capsulotomy, synovectomy, cheilectomy, arthroplasty and sympathetic nerve operations. There are other operations, such as colectomy, thyroidectomy, parathyroidectomy and operations for visceroptosis and ventral hernia.

THE DENTAL ASPECT OF ARTHRITIS

The relationship between dental and orthopedic surgery is at times very close. It is of special importance in arthritis and other rheumatic conditions in which dental infection is so commonly the cause of systemic and joint disturbances.

In a discussion on fractures, Lockwood said, "Bones are supposed to be filled with red and yellow marrow but in reality are filled with black ingratitude." To paraphrase this statement, one might make a similar statement about teeth. They are supposed to be filled with a pulp or guttapercha; in reality, they are often filled with black ingratitude for the dentist and patient.

One must consider both the soil and the seed. Osler popularized the conception of the soil and the seed in relation to tuberculosis. The same application may be made in the matter of the teeth; that is, the soil is the patient's general and local resistance to infection, the seed is the organism which produces the infection.

In 1801, Benjamin Rush recorded the cure of a patient with rheumatism of the hip by the extraction of a tooth. In 1818 he said: "I have been made happy by discovering that I have only added to the observations of other physicians in pointing out a connection between the extraction of decayed and diseased teeth and the cure of general diseases."

The dentist looks at his own work through rose-colored glasses. When a patient goes to another dentist, the latter is liable to say: "Madam, you have had beautiful dental work done. Technically, it is perfect, but if I had certain of those teeth in my head, I would regard them with great suspicion." We have all seen patients from whom all but three or four teeth have been removed because of infection. According to the law of probabilities, those remaining are potentially infected teeth. The few remaining teeth are saved and guarded as key teeth for the application and anchorage of prostheses. To my mind, the situation of

TABLE 3.—ETIOLOGY OF DENTAL DISTURBANCES

- Age
- Heredity
- Race
- Developmental anomalies
- Nutritional disturbances
- Metabolic disturbances
- Infection
  - Local
    - Root canal
    - Pyorrhea*
    - Jaw
  - Systemic
    - Tonsils
    - Gastro-intestinal tract
- Trauma
  - Toothpicks
    - Regular
      - Knife
      - Corkscrew
    - Substitutes
      - Rubber bands
      - Floss
  - Fillings
  - Crowns
  - Prostheses
  - Fractures
- Neurogenic
- Myogenic
- Neoplastic
- Miscellaneous
  - Pregnancy
  - Intercurrent infections
  - Glandular

*Cigars that are placed on infected surfaces and then in the mouth are a source of infection. Chewing blades of grass may introduce infection.

many of these patients can be considered analogous to that of one sitting on a stick of dynamite.

Etiology.—A discussion of dental disturbances should include their relation to acute, subacute and chronic conditions. In this paper, arthritis is the only condition considered. No one at this date need apologize for emphasizing the importance of the teeth to the general health of the individual.

Hayden says that the most convincing experimental proof of the causal relation of dental infection to systemic disease is that gained from the injection of animals with cultures of bacteria recovered from chronic foci, and producing disease.

The presence of dental infection in cases of arthritis does not prove that it is the cause of the disease. It is difficult to determine whether the tooth infection is due to the underlying cause of the arthritis, or the arthritis due to the infection of the tooth. The chief avenues of dental infection are: (1) the root canal, (2) the gums and (3) the blood stream. This blood stream infection must be carried from some other foci, the most important of which are the tonsils, genito-urinary, gastro-intestinal and respiratory tracts. The possible factors in dental disturbances are listed in Table 3.

Malocclusion is important because the health of the individual depends, to a considerable degree, on the digestion of food, and the first process in the digestion of food is mastication. The force of the bite should be directed along the long axis of the tooth, and this cannot occur when the teeth are malformed. When there is mechanical disturbance in the bite, there will be stress and strain thrown on the teeth, which, in turn, favors loosening, decay, bone absorption and pyorrhea.

Some dental surgeons feel that the condition of the saliva is one of the most important factors in dental decay. If this is true, and there is no reason to doubt it, one can see the importance of the general health in the determination of the character of the saliva. Saliva is a product of secretion of the salivary glands, which receive their nutrition entirely from the blood and lymph supply; therefore, it is the composition of the blood and lymph which determines the character of the saliva.

It is possible in animals to produce defective teeth by diets which are deficient in vitamins or mineral salts, or both. The formation and development of the jaw and teeth depend to a considerable degree on the food. If it is true that the food determines to a large extent the structure and health of teeth, the arthritic problem must go back to the child's teeth, and even farther, to the mother's health during pregnancy.

Mrs. Mellanby[1] concluded that the development of perfect teeth depends on an adequate supply of vitamin D. Sound teeth depend on sound diet. If the diet is correct, the teeth can be trusted to remain sound, no matter what conditions prevail in the mouth. Correct diet means, in the main, a sufficient quantity of vitamins A and D. Deficiency of vitamin A leads to hypertrophy of the subgingival epithelium and subsequent invasion by pathogenic organisms. Deficiency of vitamin D leads to defects in alveolar bone. A significant fact is the importance of adequate diet in early life when the teeth and periodontal tissues are developing.

Mrs. Mellanby concluded further that the incidence and progress of caries of the teeth either fully or nearly fully cal-

1. J.A.M.A., London letter, 96:1324 (April 18), 97:1548 (Nov. 21) 1931.

cified can be considerably retarded by the addition of fat soluble vitamins to a normal diet. The similarity of the results obtained from cod-liver oil and from viosterol suggests that the potent factor in the retardation is Vitamin D.

Mouth Hygiene. — Thompson, of Toronto, in an excellent talk on the subject of "Teeth Fallacies," stated that building teeth is like building a home and requires various elements including minerals. Enamel is a protective coating for the crown, like a copper cartridge. It keeps bacteria out. The crown of the tooth is completely formed long before it can be seen.

Ninety-five per cent of people have decayed teeth. It is stated that 98 per cent of a group of people in the Swiss Alps have perfect teeth. The crowns of the teeth are formed during the third month of fetal life. Of great importance is the diet of the mother and the child. This includes the natural foods, raw foods, raw and cooked vegetables, raw and cooked fruits and the dairy products. Potatoes in their jackets are very good. Prenatal care is very important.

At 7 years of age, every crown is completely formed and developed in every tooth, except the permanent molars. One should brush the teeth after every meal and at bedtime. It is wise to brush the teeth after any food intake, but especially after taking starches and sugars, such as candy. Foods are very important in the production of decay. The chronologic events are: food intake, fermentation, acidity, cavity formation, bacterial invasion and decay. The worse offenders are the carbohydrates, starches and sugars.

The subject of dental caries is in an unsettled state at the present time. No one knows the exact cause of dental caries. Theories have changed several times during the past few years. The situation is analogous to that obtaining as regards rickets fifteen years ago. This subject, it is hoped, can be put on a firm scientific basis within the next few years.

The pulpless tooth and its potentialities as a focus of systemic infection has become a very controversial subject. One of the most important considerations is whether it is possible to sterilize a pulpless tooth. Some writers assert that it is impossible to sterilize the pulp canal and the dentin.

In a discussion of chronic rarefying osteitis with granuloma tissue, Ennis says that its importance, from the clinical standpoint, is that the contents of the spaces including bacteria and their products produced by periapical bone absorption are directly connected with the general circulation through the blood vessels and lymphatics in the walls of the cavities and running in all directions through the granulation tissue; and while the outer layers of the granulation tissue may be denser and more fibrous than its inner portion, tending to prevent local spread of infection, there is no positive limiting membrane in the sense of preventing its contents from entering the general circulation and being deposited in distant structures of the body.

Usually, the dental root cyst is sterile, its greatest evil being its destruction of the bone by pressure, a destruction sometimes so great as to cause a pathologic fracture. These cysts should be removed surgically.

In a condition known as alveolodental periosteal abcess, Ennis states, there is an inflammatory process set up in the alveolar dental periosteum independently or in the absence of any disease of the pulp, the latter retaining its vitality or being only secondarily involved. In this type, the organisms gain entrance from

the gingival margins or from neighboring diseased teeth or are carried from other parts of the body by the blood stream.

Periapical Dental Lesions. — Lesions of this type, according to Ennis, are the most important with which one has to treat from a roentgenologic standpoint because they so frequently occur in the absence of clinical symptoms or signs, and roentgenographic examination becomes the principal means of diagnosis. In the majority of cases, the disease results from infection following death of the pulp, the bacteria passing up the root canal and out into the apical tissues through the apical foramen. Bacteria may also be carried from other parts of the body by the blood stream and lodged in the periapical tissue of pulpless teeth, or teeth containing necrotic pulp tissue. This infection may follow dental caries, or inflammation or death of the pulp. It may result from trauma or artificial devitalization by the dentist. Medicinal chemical irritants might be the agents preparing the way for bacterial infection. It is safer to regard infection by living bacteria as the essential cause of long standing periapical abscess. Absolute asepsis in performing root-canal operations is imperative because of the danger of introducing streptococci of the mouth into the periapical tissues. The original infection, in practically all cases of periapical disease, is streptococcal. If the streptococcus is hemolytic in type and of high virulence, and the resistance of the patient is low, the inflammation will be acute and may result in acute abscess formation. If this does occur, with evacuation of the pus under treatment, the condition may rapidly subside with practically no detachment or destruction of the alveolodental periosteum and no appreciable destruction of bone. In case the invading organism is of the viridans type and of low virulence, the inflammatory reaction is apt to be chronic, giving rise to little apparent disturbance but slowly progressive and proliferative in nature. The first change seen in the alveolodental periosteum is the thickening of the tissue which is infiltrated with various blood elements, but especially polymorphonuclear and small round cells, particularly the latter.

Pathology.—In his chapter on dental pathology in relation to roentgenology, Ennis discusses the following conditions: periapical dental lesions, which include proliferative alveolodental periostitis, chronic rarefying osteitis, chronic rarefying osteitis with granulation tissue, chronic rarefying osteitis with suppuration and chronic rarefying osteitis with cyst formation; and lesions involving the investing tissues of the teeth: periosteal abscess, condensing osteitis, pathologic conditions of the dentin, adventitious senile dentin and calcareous degeneration of the pulp, absorption of the teeth and external and internal absorption.

The bacteriology of the teeth, jaw and gums has not been thoroughly settled.

EXAMINATION

Ennis states that the most convenient and reliable means of determining pulp vitality is by the faradic battery or the vitalitester.

Enlargement and tenderness of the cervical lymph glands should always be suggestive of dental infection.

Roentgenography.—For those whose mouths are hypersensitive to the insertion of the roentgen-ray films, Ennis has advised dissolving a lozenge of some anesthetic substance such as ethyl aminobenzoate or a calcidin troche in the

mouth several minutes before the film is to be inserted. A complete dental film includes fourteen exposures of the mouth.

Light areas on a roentgenogram are spoken of as radiopaque; the darker areas as radiolucent. The roentgenogram does not lie, but its interpretation is difficult. Its indications are always days or weeks behind the actual pathologic process. Ennis says that the interpretation of roentgenograms is not a demonstration of expert crystal gazing. Just as a roentgenogram is usually negative during the first few days of osteomyelitis, so may the dental film be negative in the presence of early infection. I do not know whether stereoroentgenograms of the mouth can be made. It has been my thought that dental stereoroentgenograms would be of value in certain obscure dental conditions. My suggestion would be to insert two films in the mouth at the same time instead of one. The back of film 1, which is nearest the teeth, should have a metal sheet attached so that, after it has been exposed, it may be removed, film 2 being left in place. An exposure from another angle would then be taken, and these two films may then be stereoscoped.

Ennis states that the diagnostic value of the roentgen rays in inflammatory processes affecting the teeth and the surrounding parts is governed entirely by the variations in the density of the hard tissues as a result of the inflammation.

When a substance offers little or no resistance to the passage of the rays, the negative will show a darker area or line, the darker part being designated as radiolucent. When the rays pass through tissues of greater density, which offer higher resistance and absorb the rays more nearly, the term "radiopaque" is used.

In acute localized infection, the inflammatory process being of too short duration to bring about an appreciable amount of destruction of the bone tissue, the roentgen ray is of less value. It is in chronic, long-standing types of infection or in an acute process grafted on a chronic one that this method of diagonsis finds its greatest field of usefulness. The roentgenogram being merely the result of roentgen rays passing through tissues of various density and registering on a photographic emulsion, the density of the various tissues through which the ray passes controls the amount of radiation that reaches the photographic emulsion.

In roentgenograms of the jaws, the tissues and substances depicted in the order of their density begin with the pulpless tooth; therefore, appearing the lightest in the negative are: (1) metallic crowns and fillings, (2) root canal fillings and other materials, (3) enamel of the teeth, (4) dentin, (5) cementum, (6) cortical bone, (7) cancellated bone and (8) medullary spaces, canals, foramina in bone and soft tissue.

From a clinical and pathologic standpoint, there are in general two types of lesions associated with the teeth in which examination by the roentgen rays is an aid to diagnosis and prognosis: (1) lesions involving the periapical region of the tooth, resulting from infection following death of the pulp, and (2) lesions involving the investing tissues of the teeth, the alveolodental periosteum and the alveolar process not dependent on the death of the pulp, but in which the infection starts at the gingival margin. Pyorrhea alveolaris or, more correctly, chronic suppurative alveolodental periostitis is an example.

In the roentgenogram, an area of chronic rarefying osteitis with suppuration appears blurred and of somewhat

lessened density as compared with the surrounding bone, presenting irregular and ill-defined margins into which the roughened tooth apex projects. The more active the suppurative process, the more irregular and ill-defined the margins of the lesions in the roentgenogram.

Diagnosis.—Until the lipiodol method was used, diagnosticians depended on the use of wire in the root canal. There is considerable danger of the wire passing through the apical foramen and penetrating the tissue structure of the apical region, and introduction of infection thereby is no rare result. The true shape and size of the root canal under treatment may not be accurately determined by the use of the wire. The imbedding of wires in a cavity, beyond the possibility of removal except by delicate surgery, is not unusual. This may require extraction or root amputation. The lipiodol method is safer. Lipiodol is an iodized vegetable oil, the product of the intimate combination of red poppy oil with pure metalloid iodin without any trace of chlorin.

Ennis describes the localization of root canals and fistula tracts by the use of lipiodol. Two methods are given:

1. The paper point made by Johnson and Johnson is saturated with lipiodol diluted with camphomonochloral-phenol and, with the small excess of fluid that will easily adhere to the point, the latter is carried into the root canal with a slow pumping movement. If the procedure is carefully executed, the lipiodol will be carried into the apical region of the tooth and will adhere to the walls of the canal and the point can be sealed in the canal with guttapercha. Any excess lipiodol should be removed from the external surface of the crown.

2. Lipiodol may also be injected into the canal by means of a Luer syringe. A small amount of lipiodol is placed in the syringe and a blunted needle attached. Enough unvulcanized rubber to fill the cavity of the tooth is placed around the needle. The needle is then carried to the opening of the root canal and the unvulcanized rubber surrounding the needle is pressed tightly in the cavity. A slight pressure on the syringe releases the lipiodol into the root canal. Both needle and attaching rubber are withdrawn and the paper point saturated with the lipiodol solution is inserted in the canal and sealed. The roentgenogram will then reveal the outline of the canal clearly.

Treatment.—Every pulpless tooth is potentially infected; but that does not mean that all such teeth should come out.

Root-canal treatment requires an extremely intimate perception of the most minute affections, extreme caution in procedure, a delicate technic in operation and an abundance of patience.

Price discusses the question of the possibility of sterilizing a root canal. A large number of experiments show the complete futility of all efforts in this direction; and, further, the fact that root fillings constitute an added danger because, as the solvent is absorbed, shrinkage takes place and the resulting cavity forms a locked bacterial nidus.

Gould states that until such time as dentists will agree on some standardized procedure, extraction of all pathologic root-canal-filled teeth in adults is advisable. In some cases, needless extractions will be made, but an edentulous mouth is more hygienic and safe to the individual than several questionable teeth among sound teeth, awaiting a lowering of resistance or a toxic overload, which may be followed by permanent injury of heart valves, stiffness of a

joint or chronic invalidism with arthritis deformans.

In an excellent discussion of this subject, Logan states as axiomatic that all teeth affected by pyorrhea or chronic infection about root ends which cannot be controlled must be extracted or the dentist must stand convicted before the medical profession and the public as being unable or unwilling to care properly for the health of patients in accordance with the findings of the most scientific investigators. He predicted that chronic infections associated with teeth will not be effectively managed until the dentist's education includes more of bacteriology and general pathology and the physician's knowledge of dental pathology is more comprehensive.

Dental films of all pulpless teeth should be secured by everyone at least every two years and perhaps oftener, regardless of the absence of any untoward signs or symptoms, for, as Price said, local comfort not only is not a certain index of success or safety but also constitutes both what is probably the greatest paradox and costliest mistake through loss of health and life that exist in both dental and medical practice.

There are three important types of teeth that offer ground for considerable controversy: (1) the perfectly filled tooth with a small periapical abscess; (2) the imperfectly filled tooth with a small abscess, and (3) the tooth not filled, but with an abscess. In the first case, a perfectly filled tooth with a small abscess, one may adopt the policy of watchful waiting, and as long as no systemic symptoms develop, extraction may be deferred. In the second case, an imperfectly filled tooth with small abscess, two courses are offered: (1) to remove the filling and fill perfectly and watch the progress of the abscess, or (2) to extract the tooth immediately. In the third, a tooth not filled, but with an abscess, two courses are offered: (1) to fill the tooth perfectly and watch the abscess, or (2) to extract immediately.

One must decide, first, whether a tooth should be removed and, secondly, when it should be removed.

I have divided the subject of extraction of teeth under three heads: 1. Why extract teeth? 2. When to extract teeth. 3. When *not* to extract teeth. Under the first, "Why extract teeth?" I wish to state briefly the reasons. These include two main groups: (1) local conditions and (2) general conditions.

The local conditions calling for removal of teeth include conditions in the teeth, in the gums and in the jaw bone. The general conditions calling for removal of teeth include such conditions as heart disease, kidney disease, rheumatism, arthritis and eye diseases.

Under the second topic, "When to extract teeth," I have considered (1) the local condition of the teeth and (2) the general condition of the patient. Whenever possible, one should wait for the disappearance of symptoms of acute infection. These symptoms, which are due to absorption of poisons produced by the germs, are indicated by fatigue, weakness, abnormal blood count and sometimes fever.

Concerning the third topic, "When not to extract teeth," in general one may say that it is not advisable to extract teeth when the patient shows symptoms of intoxication or poisoning; when the local condition is very acute; when there is danger of overwhelming the patient with poison, which is practically always released and usually becomes absorbed, and when there is danger of tipping the scale against the patient's resistance.

One must decide what should be done with the tooth under discussion under normal conditions, and contrast that decision with what should be done under abnormal circumstances. The dental specialist should consider the following: 1. The diagnosis of the condition of the tooth or jaw bone. 2. Determination of the proper treatment of the diseases and condition found. 3. What is of great importance, the general condition of the patient.

The dentist or extraction specialist should ask: 1. Is the removal of the tooth attended by unusual risk in ordinary cases? 2. Is the removal of the tooth attended by unusual risk in the case of the patient under consideration at the present time?

One should never forget the patient and the diseased tooth or jaw. It is very easy, in one's enthusiasm to relieve the source of infection by immediate removal of the diseased tooth, to do more harm than good. Crowe advises conservatism in the treatment of foci of infection. He does not consider there is any urgency in removing the teeth unless they cause fever, and when they do, he cautions one to beware.

Pulpless teeth act in some cases as foci of infection. If the disease persists and no other obvious focus is present, the pulpless teeth should be removed. One should reinforce a patient's resistance mechanism before a tooth is removed. Removal of a tooth should not be an emergency procedure except under unusual and extenuating circumstances.

Extraction of the teeth may fail to relieve the joint symptoms because a secondary focus has become active in distant and unsuspected parts. When, in a hypothetical case, a tooth that is the cause of arthritis is removed and a flare-up of the arthritis occurs, the extraction of the tooth is analogous to the injection of a large dose of vaccine.

Whether the affected teeth shall all be removed at one sitting or extracted in relays should be decided in each case by consideration of the patient's condition, and to some extent by the number of teeth infected. One offers a warning here against the removal of more than one tooth at the first extraction.

Removal of an infected tooth resembles administration of a dose of vaccine; and vaccine should never be given in an overwhelming dose. Formerly, I was happy to hear of a reaction following the removal of a tooth because it proved the relationship of the tooth to the arthritis. At the present time, I feel it is incorrect to thus overwhelm the patient. One should shock the germs but not the patient.

A most interesting piece of scientific work is a combined work of Dr. Hoffman, of Pittsburgh, and Dr. Way, a veterinary surgeon, of New York City. Dr. Way has been called on to treat many very valuable horses which have developed arthritis. Briefly stated, he routinely sends blood of the horse to Dr. Hoffman, who, following the technic of Burbank, performs complement fixation tests against known antigens. Teeth are extracted and examined bacteriologically and an autogenous vaccine is made and added to the vaccine made from the known antigen determined by the complement fixation test. Combining these vaccines and giving them to the horse in comparatively small doses has resulted in striking cures.

I hope that the day will come when the dentist will occupy the position of a specialist in general medicine and surgery such as the throat, nose and ear specialist or the bone and joint surgeon occupies. The dentist should be a doc-

tor of medicine who specializes in dentistry. There are several encouraging signs. One is the dental residency in some of the hospitals, such as Cook County, Michael Reese and St. Luke's. This type of training is very valuable to the dentist, to the physician and to their patients.

CONCLUSIONS

The relation of arthritis to dental infection is an alluring subject. Similar pathologic changes may be produced by grossly dissimilar causes. One must differentiate sharply between cause and effect and coincidence.

It is the general practitioner who will be the important cog in the wheel of progress in the fight against arthritis. The laboratory workers, the specialists, including the dental specialists, must all work together to place all information and the necessary armamentarium in the hands of the general practitioner. He must realize that the prodromal symptom of arthritis may be a cold clamminess of hands or feet or a paresthesia of the hands or feet. A plea is made for better teamwork between the medical clinician, the bacteriologist and the dentist.

When you as dentists examine a patient with suspicious teeth, I would advise that you ask whether there are any symptoms which might be interpreted as rheumatic. If there are vague pains and aches, stiffness, swelling of the fingers, knees or other joints, tenderness, incomplete movement, neuritis in the arms, or so-called sciatic neuritis, get in touch with the patient's physician and have a free discussion with him concerning the relationship of the teeth to the patient's symptoms. It is by this form of teamwork that the patient will benefit: and what is for the good of the patient is for the good of his dentist and his physician.

ORGANIZED EFFORT AND DENTISTRY'S PLACE IN THE SUN*

By CHARLES H. MAYO, M.D., Rochester, Minn.

AGES ago, those of the medical profession who took up the art of dentistry broke away from the general profession, and this separation was for a time more and more marked. For a time, the dentist was intermediate between the physician and the barber. It is said that, among the Arabians, extraction of teeth was sometimes inflicted as a punishment for a felony, or for disobedience to the church, etc. This punishment was inflicted by the executors of public justice. Naturally, then, the doctors would have little to do with dentistry as then practiced by quacks.

Now, there are more than 67,000 dentists in the United States, and 155,000 physicians. Dentists are progressive and well organized. The Dental Educational Council of America, according to a recent classification, reported thirty-one

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dental schools listed in Class A, and eight in Class B. Through concentrated, coördinated efforts of alumni, dental education has been regulated and expanded. There is one dentist to every 1,700 persons. Therefore, America leads the world in dentistry and dental training, in spite of the fact that it has been estimated that only one fourth of the American people receive dental service.

The World War made opportunity for great progress in medicine. In fact, it extended medicine to benighted countries, and since the war, I think, more people have been preserved to the world than were lost in the war, owing to the extraordinary results of preventive medicine the world over. It was the first war that concerned English-speaking people and in which physicians had any measurable authority in care and prevention of disease. It was the first war in which dental service was given. Thousands of dentists, with full equipment, looked after the American soldiers in training camps and in foreign lands. This did much to make the world appreciate the modern dentist, and what might be accomplished if an opportunity were given. School children are now protected by the school dentist, or the local dentist, as well as by the school or city physician and the school nurse. The public is becoming considerably concerned over its health, how to secure better health and how to prevent disease.

We are a world educated by newspapers. Our great daily newspapers believe in rational, standardized medicine, and almost every edition has a column from a physician concerning health, and its preservation, or disease and its prevention, written in such a manner that even he who runs may read and understand. Newspapers have been powerful agents in making people interested in health, for they have championed the cause of school physicians, school nurses, hygienic and sanitary surroundings, and all those influences which go to make a sound mind and a sound body.

All who have been in practice several decades get visionary ideas concerning the beginnings of disease, for much of their time is spent in care of the sick. I believe most of the older men in the medical profession are more interested in prevention of disease than they are in its cure, for prevention is wholesale and cure is retail in effect, and so much of disease seems unnecessary.

The value of yearly health examinations cannot be overestimated. The first one gives the individual an opportunity to know how much health he has in his bank account, and something with which to compare the findings of future examinations. To make these yearly examinations will also be good for the physicians, because they are not trained so thoroughly in examination of healthy people as of the sick. A great question is: Can the beginnings of disease always be determined by health examination before a break in health is appreciable? A negative report is not a positive proof that the patient is healthy. Diseases which recur may be in a quiescent stage at the time of examination, but a positive finding is of value. Only one third of the evidence given by roentgenographic examination is of positive value. Dentists make marvelous use of roentgen rays. Dental roentgenograms were first made by C. Edmund Kells in 1902, in showing hidden diseases in the root, concealed destruction of enamel, abscesses of the jaw and local loss of calcium.

Dentists have divided their work into specialties, some devoting their time to the mechanical side of the practice. We are not all of a mechanical turn of mind,

but those who are can do better work along such lines. In the early days, when there were but few dentists in our section of the country, I had a large experience in extracting teeth. I used to "throw in" this service at the end of a surgical operation, which was when the patients were still asleep, they having previously accepted my offer to do it. Now, surgeons "throw in" the service of removal of the appendix in general and abdominal surgery.

Dentists have definitely improved in the mechanical art of the four divisions of dentistry, and many are advancing knowledge concerning the fundamental reasons for the decay of teeth, changes in calcium, elective localization of bacteria and injury to the body through oral infections, which act as foci. Whether they will or no, the dental profession is being forced into a necessarily greater knowledge of the body and its ailments. The modern dentist, to satisfy public demand, must not only assume greater responsibility in the care of the teeth, but must also be able to recognize bodily diseases which are manifest in the mouth, of which there are twenty-eight, that he may give timely advice to his dental patients. Signs of measles and scarlet fever can be noted in the mouth twenty-four hours before they appear on the body. Dentists have an opportunity to see changes in the calcium of the teeth, evidenced by their decay, softening and breaking, which is directing the attention of many to the subject of nutrition. In the past two years, half of the papers written on the subject of nutrition have come from dentists.

Galen, in 131 A. D., made some interesting observations on the relation of food to the incidence of oral disease. He wrote:

> The lack of nutrition makes the teeth weak, thin and brittle. An excess of nourishment excites a kind of inflammation similar to that of the soft parts. A deficiency of nourishment not only causes the tooth to die away, but also enlarges the cavities.

According to Galen, then, dental caries is a matter of metabolism.

We all appreciate that many people, some of them very old, who have never used a toothbrush, or taken any care of their teeth, have marvelous teeth. The children of men who died in the eighties or nineties take pride in saying that their fathers or grandfathers had all of their teeth when they died, or that they had lost only one or two. Some people apparently inherit higher resistance than others. Inheritance should be a factor because, with all we know about the breeding of domestic animals of all types, we expect the progeny in a considerable degree to resemble the parents.

It is now shown by McCollum of Baltimore that decay of teeth is a very simple process induced by calcium-phosphorus imbalance and lack of proper vitamins.

All physicians, regardless of their specialty, should do as the general practitioner does: look in the mouth; for within it, as has been said, more evidence of general disease will be noted than in any other part. Often, examinations of the oral cavity are conducted in the throat department, or in the dental department, but the clinician loses an opportunity if he, also, does not look into the mouth. Specialism in medicine and dentistry has delayed acceptance and appreciation of the importance of foci of disease. Thus, the man with herpes zoster, or shingles, instead of going to see a physician, often should go to see a dentist, but this would occur only by the merest chance, and it would be the merest chance that the dentist who saw the man suffering from shingles would

recognize that they might be due to an infected tooth, and neither of them might recognize, when the diseased tooth was removed, that permanent cure of the shingles was due to the dental work. Now, more than ever before, we need the all-round diagnostician in both dentistry and medicine.

Doctors accept all they are taught in medicine to the time of graduation, but later may be highly resistant to new information. Especially is this true of the specialist who sees only the diseases that afflict the part of the body on which he works. The painless, infected prostate gland should be found by the ophthalmologist, as well as the infected, granulated uterine cervix. At least, he should request the examination, and describe to the examining physician what he is looking for and why. The general practitioner or orthopedist should become interested in these same regions and in the teeth, when he has a case of rheumatic disease of the hands or vertebrae, and pain in the lumbar muscles. I have seen many diseases of the eye cleared up by massage of the prostate gland, or by enucleation of the uterine cervix, within ten to fourteen days and the patients regard as marvelous the relief given them.

Disease and eventually death comes to all of us. Many of us do not recognize that we are suffering from a disease throughout life, and, at the acme of our business lives, death comes suddenly. All laymen seem quite relieved, although they may feel unfortunate, to find that they are suffering from some air-borne contagion like influenza, rather than from something worse. In its secondary processes, influenza may cause great havoc, especially in the brain, spinal cord, heart, lungs, or other essential organs and may cause prolonged sickness and a high death rate.

We have eliminated the mass destroying diseases through public health work, through the activity of health officers of high efficiency and by education of the public. Especially have we taken better care of babies and children, and have thus advanced the average age of man, we say, to 58 years. Now there is a big cry that the death rate is increasing among older people. This is true because we have more older people. The age limit has been advanced, and they must die of something. That cancer is on the increase is looked on as a failure of medicine, but when we realize that only 5 per cent of cases of cancer afflict people less than 35 years of age, we see that there must be more people now who have reached the age when degeneration of various tissues is commonly found, and later cancerous change appears. The present average age of man seems about as high as it will become if we depend only on the assurance of pure water, pasteurized milk and inspected foods, quarantine of infectious diseases and all that can be done to prevent disease. We are now dying an individual death, not a collective death from epidemics. Health depends on what one does, not on what one knows. Health and prolongation of life are largely in one's own hands. Obesity in middle age lowers resistance and makes opportunity for widespread disease. A few years ago, reports of insurance companies showed that man at 50 years of age who was 50 pounds overweight had only half the life expectancy that he would have if his weight were normal; whereas, the man at 50 years of age who was 5 pounds underweight had five years of increased expectancy of life.

The work that the dentists have already done concerning focal disease has been a great incentive to physicians to

send their patients to the dentists in the search for infection. Dentists could well recognize signs of anemia and local recurring diseases and send the patients to the physician. Dentists could tell patients that their tonsils should be investigated.

We will not be ready for state medicine for many years, until we know with more certainty means to detect idiosyncrasies and tendencies to disease of individual patients. It will take years before investigation discloses causes of disease of individuals, and before we are able to control these causes through public education. This is a Utopia not yet in sight.

The things that we die of are little things in the beginning, and although the mouth has a part in furnishing bacteria for secondary lesions of the body, the prostate gland and the uterine cervix, both perhaps painless, supply organisms which produce acute, chronic and recurring disease. These foci should be suggested by the dentist in his effort to aid in clearing up infection. A focus of infection is painless, because, as in the dental root abscess, the nerve is dead. There may be no evidence of local reaction or inflammation.

Acute conditions occur as certain seasonal epidemic colds appear, and are accompanied by a rise in body temperature to approximately 102 F. The patient becomes depressed, is weak, looks definitely sick and often has a low blood pressure. He is nervous, and has pain in the muscles or joints. If a culture is made from the pharynx and the back of the nose of these patients who complain of symptoms of a cold, a neurotropic type of organism may be found. Intravenous injection of animals, such as the rabbit and guinea-pig, with these organisms makes the animals sick, or kills them, postmortem revealing an acutely inflamed brain, without meningitis, or possibly with meningitis alone. The tonsils, which so often are a source of focal infection, may not be inflamed, and the gum about the tooth which is the source of root abscess may not be red. There is no congestion in the immediate vicinity of the chronic focus of infection.

The very fact of inflammation being present gives opportunity for immunity to be developed by the individual. It is the chronically infected prostate gland, the chronically infected tonsil, the chronically diseased tooth that is dangerous as a focus of infection.

There are several varieties of germs which may cause destruction of teeth. They are like weeds on the farm. If wild mustard is not taken care of early, it will gradually spread over the entire farm. Similarly, organisms which first appear in the mouth may become adapted to several regions of the body and multiple foci develop. If one lives on with an infection, the urine constantly will be passing off these germs, which may be a dangerous type of streptococci. Give to the public the suggestion that infections are not all in the mouth. If you can make the public think of disease prevention as a personal responsibility, it is half the battle. Those who practice preventive dentistry are practicing preventive medicine, and will come more and more into favor with the public.

A STUDY OF THE COST OF DENTAL EDUCATION

By MIRIAM SIMONS LEUCK,* Chicago, Ill.

FOREWORD

The Committee on the Study of Dental Practice herewith presents the final report in the series of studies contributed by the American Dental Association to the Committee on the Costs of Medical Care. These studies were undertaken at the request of this committee to secure factual information that would shed light on the problem of "providing adequate scientific medical service to all the people rich and poor at a cost that can be reasonably met by them in their respective stations of life." These studies have included (1) the field of dental income, (2) capital investment in office equipment, (3) cost of dental education, (4) compulsory health insurance, (5) dental clinics (two studies) and (6) a summary of the facts relating to dentistry as disclosed by the studies of the Committee on the Costs of Medical Care. The costs of the statistical analysis and the presentation of the income study were contributed by the Committee on the Costs of Medical Care, and the funds for the insurance study were provided by the American College of Dentists. The study on education was directed by Guy S. Millberry.

November 29, the Committee on the Costs of Medical Care will make public the final report. Their recommendations will probably have far-reaching effects on the health problem of the people of the United States, and soon they will be a live topic of discussion among community groups. Professional understanding of the recommendations and full knowledge of the facts on which they are based will be necessary if medical and dental organizations are to assume leadership among the interested groups. This is an opportunity that we cannot afford to miss. The sooner we meet in our local societies to discuss this important subject, the more effective we will be in formulating an intelligent national policy on which our leaders can proceed. No time should be lost.

HERBERT E. PHILLIPS, *Chairman*
Committee on the Study of Dental Practice.

In surveying the cost of a dental education, the Committee on the Study of Dental Practice of the American Dental Association has endeavored to determine the expense to society involved in training a dentist. The imponderable elements of such expense, such as the time involved, could not, of course, be determined, but the concrete factors of cost to the student and cost to the university which trained him presented the means of study.

METHOD OF THE STUDY

Although a few universities had endeavored to estimate the college and personal expenses of their students, such estimates were too scattered and, according to the expressed opinion of many of the schools offering them, were too inexact for any complete study. All dental schools in the country were, however, asked to supply such estimates to supplement the information obtained by more direct methods.

The material on which this study, as far as it concerns the expenses to the student, is based was obtained directly from these students by means of expense books which were distributed either at the end of the spring term or the begin-

*Member of the Research Staff, Committee on the Study of Dental Practice of the American Dental Association.

ning of the fall term, 1931, the date being dependent on the particular college involved. These account books provided space for weekly records of college expenses, which were carefully defined, and for daily records of personal expenses throughout the year. Information was also requested regarding source and amount of income, indebtedness, marital status and number of dependents, and similar supplementary conditions which might influence the expenses of the student. These books were distributed to twenty dental schools in the country, selected in a manner which would give fair representation to such factors as geographic location, city size and status of institutions, i.e., as to whether state or private. All students at the colleges selected were requested to cooperate in the study by keeping these records as accurately as possible. Different schools employed different methods to secure the cooperation of the students, some depending on voluntary enthusiasm, some including the records as a part of a class requirement. In tabulating the data, only books which were complete and whose accounts checked were included; hence, many of the schools will find themselves credited with fewer books than they returned. As is apparent from Table 1, the study met with a varying response in different institutions, but the aggregate results illuminate the subject. Of the twenty schools first selected, only

TABLE 1.—NUMBER OF DENTAL STUDENTS PARTICIPATING IN THE STUDY OF THE COST OF DENTAL EDUCATION TO STUDENTS, 1931-1932, ARRANGED ACCORDING TO DENTAL SCHOOLS AND THE YEAR IN COLLEGE REPRESENTED BY THE STUDENT

Name of Dental School	Number of Students Registered in Class Indicated and Number and Percentage Reporting in Study												Total All Students and Reports for School		
	Freshmen			Sophomores			Juniors			Seniors					
	Number Registered	Number Reporting	Percentage Reporting	Number Registered	Number Reporting	Percentage Reporting	Number Registered	Number Reporting	Percentage Reporting	Number Registered	Number Reporting	Percentage Reporting	Number Registered	Number Reporting	Percentage Reporting
Atlanta-Southern	76	71	94	60	47	80	83	78	94	83	79	97	302	275	91.6
California	40	1	3	24	3	13	30	2	7	42	2	5	136	8	5.9
Columbia	50	21	42	44	8	18	36	5	14	47	0	0	177	34	19.2
Creighton	31	0	0	26	0	0	20	3	15	29	3	10	106	6	5.6
Harvard	37	0	0	30	2	7	28	0	0	24	1	4	119	3	2.5
Howard	10	4	40	6	2	33	17	7	41	15	4	27	48	17	35.4
Iowa	44	17	39	36	24	67	41	27	66	46	23	50	167	91	54.5
Maryland	100	0	0	86	0	0	94	19	20	65	27	42	345	46	13.3
Michigan	70	62	89	....	*	....	67	65	97	87	74	85	224	201	90.2
Minnesota	*	....	....	68	0	0	82	2	24	89	1	1	239	3	1.3
Pittsburgh	*	....	....	82	0	0	90	17	19	107	76	71	279	93	33.3
Southern California	83	1	1	79	45	57	85	47	55	90	22	24	337	115	44.3
Temple	143	3	2	131	0	0	117	0	0	133	0	0	524	3	0.6
Western Reserve	36	8	22	26	2	8	43	7	16	38	13	34	143	30	20.9
Total	720	188	26	698	133	19	833	279	33	895	325	36	3146	925	29.4

*On 2-3 year plan

fourteen returned books which were complete enough and at a date to be included in the final tabulation.

The outstanding feature of this table is the higher percentage of students in the upper two classes which cooperated in the study.

COLLEGE EXPENSES

The returns on the student expenses were divided into those termed "college expenses" and "personal expenses." "College expenses" were those concerned with strictly educational costs and tend to be more or less uniform for all students of the same class in a given university. Personal expenses, naturally, vary with personal tastes, although they too display the influence of class in school and location of the college. The first of the college expenses was tuition, the highest reported being between $550 and $600, the lowest, $190. Tuition was defined to include not only formal tuition fees, but matriculation fees, laboratory fees, graduation fees and all similar charges paid directly to the university. The distribution of these fees for the several classes is presented in Table 2.

Thus, fees, in general, reach their height at the beginning and the end of the school career, being lower in the middle years. On the whole, the highest fees of this type were reported by students in the middle Atlantic states, the lowest fees by students from colleges in the west north-central area.

For books, the average freshman spent $35; the median freshman, $35; the average sophomore, $20; the median sophomore, $19; the average junior, $31; the median junior, $30; the average senior, $21; the median senior, $16. The average dental student in 1931-1932 spent $27 for books, the median student of all classes spent $25.

TABLE 2.—NUMBER OF DENTAL STUDENTS PAYING TUITION FEES INDICATED, 1931-1932, ARRANGED ACCORDING TO CLASS IN SCHOOL AND AMOUNT OF FEE

Class in School	Number of Students Paying Fee Indicated									Total Number of Students in Class Reporting		
	$190-200	$201-250	$251-300	$301-350	$351-400	$401-451	$451-500	$501-550	$550-600	Number	Median Fee	Average Fee
Freshman	1	77	8	70	6	5	..	20	1	188	307	308
Sophomore	..	16	87	17	5	..	..	7	1	133	280	295
Junior	28	69	104	47	23	3	..	5	..	279	271	277
Senior	12	74	70	73	53	37	6	..	..	325	306	309
All Classes	41	236	269	207	87	45	6	32	2	925	286	297

In defining items for record in the expense books, equipment was divided into articles which were permanent and those which were temporary expendable materials. Such temporary materials were defined by the illustrations of cotton rolls, doilies, burs, stones, etc. The distribution of these two items according to class in school is presented in Table 3.

The sophomore year appears to mark the purchase of the largest amount of permanent equipment. In general, there was little sectional difference in the amount expended for these items, although they were slightly higher than

average in the east north-central states, and slightly lower than average in the south Atlantic area.

All of these items—tuition, fees, books, equipment—together make up the total college expenses. The distribution of these expenses according to year in school is indicated in Table 4.

It would seem that college expenditures tend to reach their height in the sophomore year, partly because of the custom in a majority of colleges to set this year as the appropriate time for the purchase of the more expensive equipment. There is little variation in expense between the last two years, the freshman year tending to be slightly more costly than either of these. The high average for freshmen may be influenced by the fact that one large metropolitan college sent reports for four times as many freshmen as for any other class. Nevertheless, most colleges displayed this tendency for high expenditures in the first year, although to a less marked degree.

Total expenses in both the freshman and the sophomore year were highest in the middle Atlantic and east north-central states, lowest in the west north-central and south Atlantic area. In the junior year, expenses were much the same throughout the country, with a slightly higher trend in the middle Atlantic area; while the senior year found the south Atlantic and Pacific sections reporting a slightly higher amount.

TABLE 3.—NUMBER OF DENTAL STUDENTS SPENDING INDICATED AMOUNTS ON PERMANENT AND EXPENDABLE EQUIPMENT IN 1931-1932, ARRANGED ACCORDING TO AMOUNT OF EXPENSE AND YEAR IN DENTAL SCHOOL

Year in School and Type of Expense	Number of Students Spending Amount Indicated											Total All Students Reporting		
	$0-50	$51-100	$101-150	$151-200	$201-250	$251-300	$301-350	$351-400	$401-450	$451-500	$501 and over	Number	Median Expense	Average Expense
Freshman:														
Permanent...	45	44	37	29	32	1	...	...	...	...	...	188	$108	$115
Expendable...	147	37	4	...	...	...	...	...	...	...	...	188	33	37
Sophomore:														
Permanent...	1	2	15	89	14	...	12	...	...	...	...	133	180	186
Expendable...	126	7	...	...	...	...	...	...	...	...	...	133	27	28
unior:														
Permanent...	43	79	57	38	43	16	2	...	1	...	...	279	116	129
Expendable...	230	44	1	3	1	...	...	...	...	...	...	279	31	36
Senior:														
Permanent...	206	40	5	15	5	5	5	18	17	11	12	325	40	121
Expendable...	275	38	9	3	...	...	...	...	...	...	...	325	31	35
All Classes:														
Permanent...	295	165	114	157	94	22	19	18	18	11	12	925	102	132
Expendable...	778	126	14	6	1	...	...	...	...	...	...	925	31	35

PERSONAL EXPENSES

Although, at first glance, the personal expenses of a dental student might not appear to enter into the cost of his edu-

TABLE 4.—NUMBER OF DENTAL STUDENTS SPENDING AMOUNT INDICATED UPON ALL COLLEGE EXPENSES, 1931-1932, ARRANGED ACCORDING TO AMOUNT OF EXPENSE AND YEAR IN SCHOOL

Year in School	Number of Students Spending Amount Indicated									Total All Students Reporting		
	$201-300	$301-400	$401-500	$501-600	$601-700	$701-800	$801-900	$ 901-1000	$1001-2000	Number	Median Expense	Average Expense
Freshman	3	63	52	44	23	3	..	..	..	188	$450	$467
Sophomore	2	17	44	58	..	4	6	2	..	133	504	513
Junior	29	80	97	25	36	11	1	..	..	279	425	448
Senior	51	88	92	27	26	23	11	6	1	325	423	459
All Classes	85	248	285	154	85	41	18	8	1	925	$444	$465

TABLE 5.—NUMBER OF DENTAL STUDENTS REPORTING ON COST OF SHELTER, ARRANGED ACCORDING TO YEAR IN SCHOOL AND AMOUNT REPORTED, 1931-1932

Year in School	Number of Students Reporting Amount Indicated								Total All Students Reporting		
	$ 1-50	$ 51-100	$101-150	$151-200	$201-250	$251-300	$301-350	$351-400	Number	Median Expense	Average Expense
Freshman	23*	59	76	25	3	..	..	2	188	$109	$108
Sophomore	35†	57	39	..	1	1	..	..	133	79	79
Junior	47‡	80	107	39	2	..	3	1	279	107	105
Senior	42#	86	107	64	14	8	4	..	325	117	119
All Classes	147	282	329	128	20	9	7	3	925	$106	$107

*Twenty-one of these lived at home.
†Thirty-one of these lived at home.
‡Forty-five of these lived at home.
#Forty-one of these lived at home.

cation, being largely dependent on his individual tastes and entering into his costs of living whatever his occupation, the amount of these expenses may be greatly influenced by his status and location as a college student. Room, board and other expenses vary from location to location, and frequently appear to vary from college year to college year, as indicated in Table 5, presenting the cost of shelter reported by the students cooperating in the study.

Of the 925 students reporting, 138 lived at home, the majority of them in the middle Atlantic area. On the whole, the highest cost of shelter was reported by students of colleges located in the east north-central states. The drop in cost during the sophomore year is influenced, in part, but not caused entirely, by the slighly higher percentage of students of that year who lived at home.

The variation in cost of food is presented in Table 6. Of the 925 students included in this report, thirty-six stated that board was received in return for work of some sort (waiting on table, caring for furnaces, etc.), and therefore the amount stated was only an estimate of the value of such work.

By far the larger percentage of students reported as working for their board were in attendence at schools in the east north-central and west north-central areas. In spite of or perhaps in explanation of this situation, the highest charges for food were reported from the east north-central area, with the south Atlantic states second.

There was little difference between classes in the amount reported as spent on laundry, the average for the entire group being $22 for the school year, the median, $19. Of the 925 students, thirty-three reported sending their laundry home, the various sections of the country following this practice to the same degree. The highest expenses for laundry were reported from the middle Atlantic and south Atlantic sections. "Laundry" was defined in the instructions to include all costs for cleaning, pressing, shoe-shining, etc., as well as actual washing.

The lowest expenses for apparel were reported in the sophomore year, when the average reported was $37, the median, $32, as compared with a freshman average of $47 and median of $41, a junior average of $48 and median of $39, and a senior average of $57 and median of $45. The average for the entire group was $49, the median $40. The highest reported expenses for clothing were from the south Atlantic area.

Transportation costs varied widely, according to individual tastes rather than class in school. The average cost of this item for the entire group was $47 for the year, the median cost, $37. Of the 925 students, thirty-three reported that they had no transportation costs; 259 reported that all travel was by rail; 156 reported the ownership or a share in the upkeep of an automobile as supplying the means of transportation, and 164 reported both rail and automobile costs. Transportation costs were reported as higher in the south Atlantic, middle Atlantic and Pacific areas than for the country as a whole.

Under the item "health," the students were instructed to record not only all money paid on bills for professional services, but also money spent for drugs, etc. There was little variation from year to year, the average for the entire group being $28, the median, $27. There was no real sectional difference in the amounts reported for this item.

"Recreation and sports" displayed a marked rise in the later college years, the average for freshmen being $35, the median, $32; the average for sophomores,

TABLE 6.—NUMBER OF DENTAL STUDENTS REPORTING ON AMOUNT SPENT FOR FOOD, 1931-1932, ARRANGED ACCORDING TO THE YEAR IN SCHOOL AND AMOUNT INDICATED

Year in School	Number of Students Spending Amount Indicated										Total All Students Reporting		
	$ 1-50	$ 51-100	$101-150	$151-200	$201-250	$251-300	$301-350	$351-400	$401-450	$451-500	Number	Median Expense	Average Expense
Freshman	18*	13	14	57	62	23	1	..	..	..	188	$194	$179
Sophomore	15†	26	7	39	38	6	2	..	..	..	133	175	164
Junior	31‡	29	24	59	93	31	12	..	..	..	279	198	174
Senior	14#	36	23	57	104	66	20	4	..	1	325	217	203
All Classes	78	104	68	212	297	126	35	4	..	1	925	$200	$184

*Nine worked for board.
†Eight worked for board.
‡Thirteen worked for board.
#Six worked for board.

TABLE 7.—NUMBER OF DENTAL STUDENTS SPENDING THE TOTAL AMOUNT INDICATED, 1931-1932, FOR PERSONAL EXPENSES, ARRANGED ACCORDING TO YEAR IN SCHOOL AND AMOUNT SPENT

Year in School	Number of Students Spending Amount Indicated												Total All Students Reporting		
	$101-200	$201-300	$301-400	$401-500	$501-600	$601-700	$701-800	$801-900	$ 901-1000	$1001-1100	$1101-1200	$1201 and over	Number	Median Expense	Average Expense
Freshman	15	12	22	36	53	27	11	9	9	2	..	..	188	$521	$506
Sophomore	18	19	14	29	28	12	7	4	1	..	1	..	133	543	448
Junior	11	23	25	58	60	42	30	14	9	3	4	..	279	550	552
Senior	5	9	38	43	62	60	44	21	26	8	3	6	325	610	627
All Classes	49	62	99	166	203	141	92	48	37	13	8	6	925	$551	$554

TABLE 8.—NUMBER OF DENTAL STUDENTS SPENDING TOTAL AMOUNT INDICATED DURING SCHOOL YEAR, 1931-1932, ARRANGED ACCORDING TO YEAR IN SCHOOL AND AMOUNT SPENT

Year in School	Number of Students Spending Amount Indicated												Total All Students Reporting		
	$301-400	$401-500	$501-600	$601-700	$701-800	$801-900	$ 901-1000	$1001-1100	$1101-1200	$1201-1300	$1301-1400	$1401-1500	$1500 and over	Number	Median Expense	Average Expense
Freshman	..	2	4	5	13	33	44	36	23	16	7	4	1	188	$ 985	$ 995
Sophomore	..	1	1	16	14	11	24	28	19	12	4	..	3	133	999	982
Junior	1	1	9	11	26	38	40	53	37	36	12	7	8	279	1,026	1,023
Senior	..	..	5	15	27	32	53	37	38	33	30	18	37	325	1,083	1,125
All Classes	1	4	19	47	80	114	161	154	117	97	53	29	49	925	$1,025	$1,047

$35, the median, $32; the average for juniors, $38, the median $33; while the average for seniors is $41, and the median, $34. The average spent by the entire group was $38 for the school year, the median, $33. Regional variations are also apparent, students in the east north-central and west north-central colleges spending more on diversion than students from the other sections of the country. In general, students in state colleges and in smaller communities appear to spend a larger proportion of their total expenditures on recreation than do students in the largest cities and in private or endowed institutions.

Churches, lodges and fraternities receive a slightly larger amount from the later classes than from the earlier groups, as indicated by the average of $32 for the freshmen, the median of $30 for the same group, the average for sophomores of $33 and the sophomore median of $30, as compared with the junior average and median of $39 and $32 and the senior average and median of $39 and $33. The average for the entire group was $37 and the median was $32 a year expended on these items.

Insurance increases greatly in amount in the last year in school. Freshmen paid an average of $31, a median of $28, for insurance. Sophomores paid an average of $30, a median of $28 and juniors an average of $31 and a median of $28. Seniors paid an average of $36 and a median of $30 for insurance, raising the average of the entire group to $33 and the median to $29 a year. More than two thirds of each of the first three classes and more than one half of the members of the senior class reported that they carried no insurance.

Miscellaneous items absorbed a larger part of the expenditures of upper classmen, the average for such items for the

entire groups being $49, the median, $37.

The total expenditures of students in the various classes for such personal needs are indicated in Table 7.

Thus, in general, the average dental student spends about $100 more in the eight or nine months of his school year on personal expenses than he does on college expenses. Whereas college expenses are highest in the sophomore year, personal expenses are lowest in that year, but tend to increase rather rapidly during the last two years of school life. The lowest amount reported for personal expenses was $121, the highest $1,340. In general, personal expenses were highest in the east north-central and south Atlantic states and lowest in the west north-central and middle Atlantic divisions.

Certain conditions may tend to modify personal expenses, even when not directly included in them. One of these, applicable to dental students, is that of the marital status. Married students were requested to make returns only for themselves, rather than for their families, but marriage would tend to create new demands on the income and give old demands a different importance.

Of the 188 freshmen reporting, only six stated that they were married; in the sophomore group, eight of 133 were married; in the junior, twenty-nine of 279, and in the senior, forty-four of 325. Thus, a constantly increasing percentage of students are married as the class progresses through school. Out of the total 925, eighty-seven reported as married.

Questioned regarding dependents, sixty-four of the total 925 students had one dependent; forty-three had two; six had three; three had four, and 111 failed to answer the question. Of the 188 freshmen, thirty had someone dependent on them. Only thirteen of the 133 sophomores had dependents, thirty-one of the 279 juniors and forty-two of the 325 seniors. Thus, although the married group and the group with dependents are not completely identical, they are nearly so, with the exception of the freshmen, who had an unusually high percentage of dependents.

The relative total expenses of members of the several classes are presented in Table 8.

Obviously, the total cost of going to school tends to increase with each year. The sectional differences in total costs, presented in Table 9, are perhaps even more interesting.

TABLE 9.—NUMBER OF DENTAL STUDENTS SPENDING TOTAL AMOUNT INDICATED DURING SCHOOL YEAR, 1931-1932, ARRANGED ACCORDING TO GEOGRAPHIC LOCATION OF SCHOOL

Geographic Location	Number of Students Reporting	Median Expenses	Average Expenses
New England	3	$1,225	$1,242
Middle Atlantic	130	1,021	1,044
East north-central	231	1,179	1,223
West north-central	100	909	907
South Atlantic	338	1,010	1,020
Pacific	123	942	913
All Sections	925	$1,025	$1,047

TABLE 10.—NUMBER OF STUDENTS SPENDING AMOUNT INDICATED DURING SUMMER VACATION, 1931, ARRANGED ACCORDING TO YEAR IN SCHOOL AND AMOUNT SPENT

Year in School	Number of Students Spending Amount Indicated									Total All Students Reporting		
	$ 1-100	$101-200	$201-300	$301-400	$401-500	$501-600	$601-700	$701-800	$801-900	Number	Median Expense	Average Expense
Freshman	1	50	15	2	..	..	..	..	..	68	$167	$176
Sophomore	65	16	5	1	1	..	..	..	..	88	69	87
Junior	55	74	23	6	..	..	..	..	..	158	133	137
Senior	72	108	47	7	1	..	..	..	1	236	144	150
All Classes	193	248	90	16	2	..	..	..	1	550	$134	$139

TABLE 11.—NUMBER OF DENTAL STUDENTS WITH INDEBTEDNESS INDICATED, ARRANGED ACCORDING TO YEAR IN SCHOOL, 1931-1932, AND AMOUNT OF INDEBTEDNESS

Year in School	Number of Students with Indebtedness Indicated											Total All Students Reporting	
	No Debts	$ 1-250	$251-500	$501-750	$ 751-1000	$1001-1050	$1251-1500	$1501-1750	$1751-2000	$2001-2250	$2251 and over	Number	Average Indebtedness
Freshman	156	8	13	6	2	1	1	1	..	..	..	188	$ 82
Sophomore	96	17	10	4	2	1	1	..	2	..	..	133	123
Junior	183	26	17	21	18	5	3	3	1	1	1	279	216
Senior	202	35	21	13	14	14	10	5	6	1	4	325	310
All Classes	637	86	61	44	36	21	15	9	9	2	5	925	$209

The number reporting from New England is too small to justify any conclusions for that section, but those reporting for other parts of the country are numerous enough to indicate plainly that, for example, the average student in the west north-central or Pacific states tends to spend less on his college year than does the average student in the east north-central states.

The average dental school year is between eight and nine months in length; hence the average expense a month while school is in session is about $115. If this figure is compared with that for living costs during the summer months, as presented in Table 10, it becomes plain that the investment in a dental education is, to the individual student, even as regards his personal expenses, a considerable item.

Thus, the average expenditure during the summer months is between $30 and $40 a month. The total number of students reporting on summer expenses is smaller than the number reporting on the entire school year, as several of the dental schools participating in the study were unable to distribute the account books before the beginning of the summer vacation; but the results are probably applicable to the average student body.

What is the probable source of this, approximately, $1,050 a year needed to finance the dental student's education? Students were asked to indicate the source of their funds. The replies to this question were too uneven to justify tabulation, but, of those answering, about one-fifth indicated that they were totally self-sustaining. Particularly striking was the large number who were carrying a rather large burden of debt in order to finance their education. Although 637, or a little more than two thirds of the students, stated that they had no indebtedness, the indebtedness of the others, as presented in Table 11, would indicate that many young dentists start on their professional career under a considerable financial handicap.

The striking increase in indebtedness as the college career progresses is obvious. Of the five reporting an indebtedness of more than $2,250, one owed $2,251-$2,500, two, $3,000-$3,250, one, $5,000 and one, $7,500. No medians are presented for indebtedness since the large number of students without debts place the median at zero. This indebtedness is about evenly divided between student loan funds and personal loans. Undoubtedly, financial conditions during the period covered by the study influenced the amount of indebtedness to some extent. These conditions should also be taken into consideration in reviewing the amount of personal expenses. Many students noted on their account books that, owing to financial conditions, they were eating only one or two meals a day or had moved to cheaper rooming quarters within the school year.

THE COST TO THE DENTAL SCHOOL

The complete cost of educating the embryo dentist is not borne by the student himself. Part of it is carried by the dental school, which is, in turn, supported by endowments or by state funds derived from taxes and from similar sources. In a brief questionnaire, the dental schools of the country were requested to supply information regarding their income and expenditures for the year 1931-1932, covered by the study.

Owing to the fact that not all of the schools were able to supply complete or uniform information, the schedules of only seventeen schools could be studied comparatively. The schools varied greatly in the relation between costs and

number of students, the lowest cost for each student reported being $313, the highest, $1,850. The average cost for each student for the seventeen schools included was $616.99.

As we have seen from the fees paid by the students, a certain amount of this cost is met by the student himself. Subtracting all income received by the university from students, the average cost to the college for each student becomes $324.01. This is a cost which must be met by the public, through taxes or endowments. If this average cost to the college is combined with the average cost of $1,047 for each student as derived from the student expense books, it is apparent that an investment of $1,371 a year, or, with a four-year course, an aggregate of $5,485, is required to create a graduate dentist, exclusive of immaterial costs.

PROGNATHISM: A STUDY IN DEVELOPMENT OF THE FACE*

By T. WINGATE TODD, Cleveland, Ohio

"PROGNATHISM" is a harmless word, which, by its very simplicity, lends itself to a variety of interpretations. The anthropologist thinks of it as indicating a projection forward of the upper jaw striking enough to excite attention. Certain peoples, notably of negro stock, have the characteristic in well-marked degree. But since the Greek word *gnathos* strictly signifies the lower jaw, the term may be used equally well for the mandible, an example of Class 3 malocclusion. I wish today to use "prognathism" as the title of a study less limited in scope and more far-reaching in significance; namely, the actual growth of the face, with special reference to the forward extension of the jaws.

In a composite structure like the skull, there is an evident relationship between the growth patterns of the several parts. The face, it is true, has its own particular phenomena of growth, but as the face is hafted to the cranium and indeed is borne upon the frontal and sphenoid bones of the cranium, it must, even were it a passive and inert structure, undergo a change in relative position in consequence of cranial growth. Usually, our attention is riveted on the internal features of facial growth, and these we shall not neglect at this time. But for an adequate appreciation of what facial growth really implies, we must extend our study to include the cranium.

No limited attack on a problem is likely to be thoroughly satisfactory. Developmental growth of the human skull is admittedly complex. The cranial growth presents features found in no other living organism, and it is this peculiarity, as I hope shortly to demonstrate, which complicates our problem. If a

*From the Hamann Museum, Western Reserve University.

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Feb. 3, 1931.

proper analysis is to be made of facial growth in man, it must be prepared for by an adequate understanding of the comparable phenomena in animals which present a less complex pattern of facial growth. But no apology is needed for setting before an audience of orthodontists a reasoned argument on comparative anatomy. The orthodontist of today does not minimize the importance of appliances, but he seeks with indefatigable ardor to base his technic upon proper scientific principles.

I do not come before you then with any partial or desultory study. Nor do I ask you to review the results of my own work alone. It would be a sheer impossibility for one man in the course of a reasonable time so to perfect his own personal studies as to gather the data necessary for a dependable interpretation of even so apparently simple a problem as facial growth. I have been fortunate indeed in facilities and personnel.

The unparalleled opportunities provided by that rich American store of human and mammalian skulls in the Hamann Museum offer a unique chance to establish the reliability of the data whereon to base a judgment. And Fortune has surrounded me with enthusiastic workers who could visualize our common goal. I purpose to lay before you the results of five years' work on which ten investigators have patiently toiled. No really scientific work is easy, and patience equals faith as a qualification in taking up the task. Though our intent was primarily a study of the subject of human facial growth, we found it necessary to

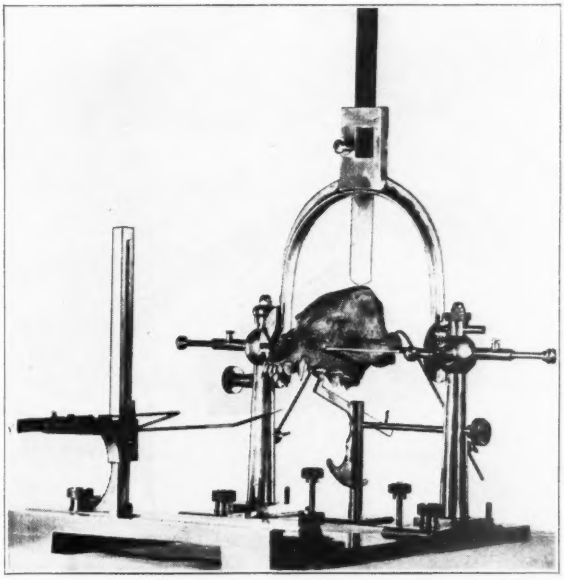

Fig. 1—Skull of hyena mounted in craniostat to show method of registering graphically quantitative features of skull. (Schweikher.)

devote attention also to hyenas, pigs, sheep, deer, baboons, orang-outangs, chimpanzees and gorillas. The principle on which we selected this Noah's ark of animals was obviously not one of zoologic relationship. It was skull growth itself.

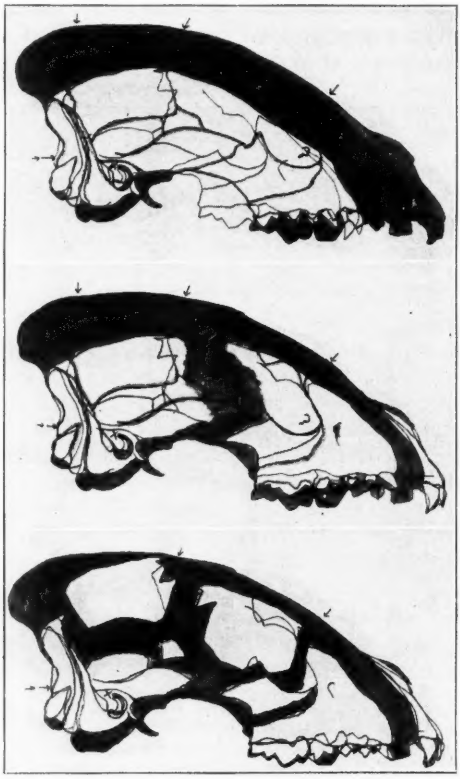

Fig. 2.—Superposition of half-grown skull of hyena upon that of fully grown animal to demonstrate loci of growth in cranium and face. (Schweikher.)

The hyena was chosen because it has a simple skull pattern. The cranium grows little after infancy. The great muscular ridges on its skull obscure, but do not hide, its essential brain-case growth. The last tooth to erupt in the hyena is the cuspid. That means relatively early stabilization at the back of the palate and rear end of the dental arch. In all the other animals chosen, the third molar is the last tooth to erupt, although it is true that the cuspid, which develops into a veritable tusk in pigs, baboons and anthropoids, presses the third molar very close in point of time and, since it is so huge, actually establishes itself in full eruption later than the date at which the molar is fully erupted.

Deer have but a small cuspid at best (except the musk deer, which does not enter into this problem), and sheep have none at all in the upper jaw. In them, we concentrate attention on the rear of the dental arch. Pigs have a late erupting cuspid and an enormous third molar which provide a suitably complicated pattern against which to check that of the sheep and deer. Baboons are long-jawed primates in which modifications of facial growth, associated with secondarily enlarged third molars and cuspids, can be followed with interest. Anthropoids provide a series of large-brained primates, akin to man, in which the facial growth is definitely complicated by the growth pattern of the cranium. They serve, you will see, as a starting point from which to attack with assurance the far greater complexities of human growth.

In what I am about to say, I have drawn freely, beyond my own researches on the deer and on man, on the finished though as yet mostly unpublished studies of my colleagues and assistants:

"Hyenas," by Dr. F. P. Schweikher; "Sheep," by Mr. R. E. Wharton; "Pigs," by Mr. E. V. Cooke, Jr.; "Baboons," by Miss R. Perrine; "Anthropoids," by Dr. W. M. Krogman; "Negroes," by Miss B. Tracy and Mr. H. A. Bowman, and "Whites," by Miss J. Forbes and Miss R. Perrine.

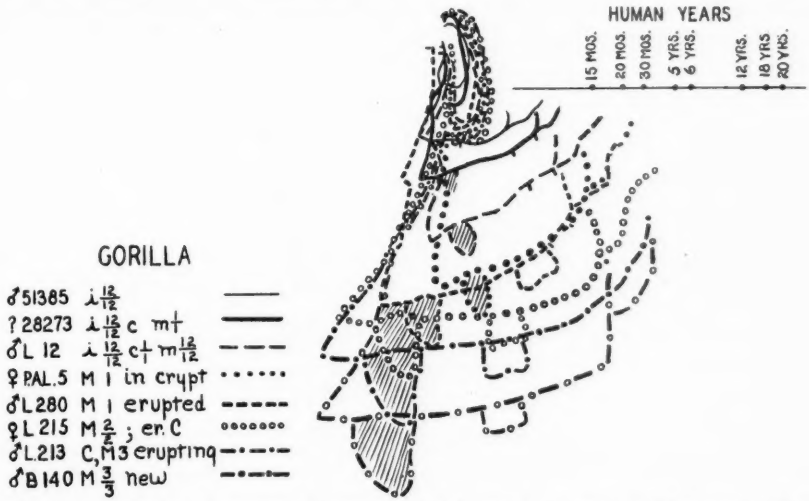

Fig. 3.—Composite of superposed stages in facial growth of gorilla. (Krogman.) The stages are marked by estimates in the equivalent of human years on the sites of porion. Forward cranial extension carries the face forward to five human years. Thereafter, facial extension occurs alone to twelve human years, the posterior part of the dental arch being stabilized during this period of growth.

Our first problem was to design and manufacture an instrument suitable for recording accurately on millimeter paper the details of skull form. This was done by Mr. Joseph Cherney. The exactitude has been tested and found reliable, but the registration is necessarily a tedious business. Figure 1 shows a hyena skull mounted in the craniostat, of which the

movable recording arm with its contained needle measures the distance of any given point on the skull from a central zero established at the porion or highest point of the ear hole. By plotting patiently the location of sufficient skull points upon millimeter paper, a true orthodiagraphic record of the skull is obtained in any chosen plane.

PRINCIPLES OF FACIAL GROWTH

To be entirely logical, one should not present the principles of a study before giving the data upon which those principles are based. And whatever working hypothesis one may start with, that hypothesis must be modified from time to time as observations multiply. But when the results of a long-term study are being laid before a group of fellow-workers for their constructive criticism, as now, it is of material advantage to state, in the beginning, the general principles which have emerged in order that the data, as they are marshalled, may be clearly appreciated and evaluated. I am therefore asking your attention to certain fundamental considerations before I give you the data which appear to me to imply these considerations.

We recognize that the face grows in anteroposterior length, in transverse breadth and in vertical height.

Since transverse growth does not enter into our immediate purview, it can be dismissed in a few words. Certain observations by H. A. Bowman on the growth in breadth of palate, zygomatic arches and bigonial measurement, made on our collection of children's skulls, show that at 4 years these diameters have already reached about four-fifths their adult value. There is the greatest velocity of transverse facial growth very early in life.

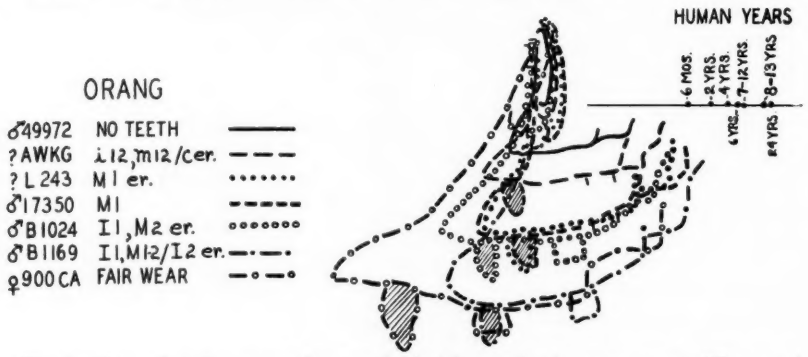

Fig. 4.—Composite of superposed stages in facial growth of orang-outang. (Krogman.) Arrangement of data is as in Figure 3. Forward extension of the brain-case ceases very early and, in the late stages, the face buckles on the nasion, lugging forward the lower orbital margin.

Vertical growth of the face between the root of the nose and the upper alveolar process can be divided into two components, that above the nasal floor and that below it. The second is plainly associated with development of teeth, the former with increase in internal nasal height. Miss Tracy has shown that vertical facial growth differs greatly in velocity and extent at different ages. Its maximums are reached during the first

six months after birth, during the third and fourth years, from 7 to 11 years, and again between 16 and 19 years. These spurts of growth correspond roughly with the spurts of bodily growth, and since increase in body volume necessitates increased respiration, one may provisionally refer to the upper facial growth, between nasal root and nasal floor, as respiratory in character. I do not wish to press this hypothetic relationship too far. It is a convenient form of expression and should be left at that.

and anteroposterior dimensions, we have to remember the hafting of the face to the cranium. Vertical facial growth clearly requires increased vertical dimension in the cranial surface to which the face is attached. And if facial growth is relatively greater than cranial growth, the face must project increasingly below the cranium. Again, anteroposterior facial growth must require an increasing anteroposterior dimension of the cranium. In the amount by which the facial growth exceeds the cranial, there will be

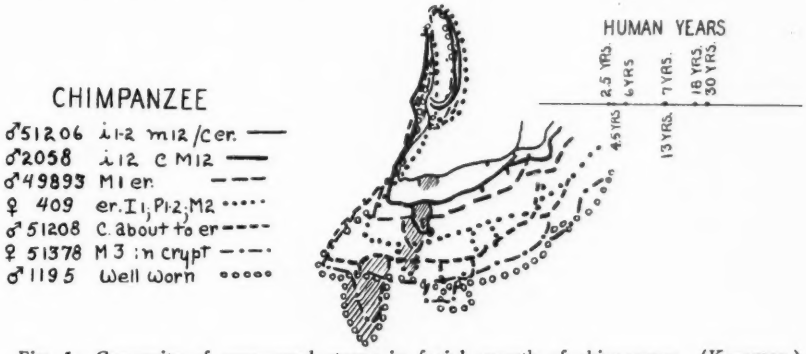

Fig. 5.—Composite of superposed stages in facial growth of chimpanzee. (Krogman.) Arrangement of data is as in Figure 3. Progressive fr ntal extension constantly modifies the position of the cuspid. The lower face only outruns the frontal projection after the stage corresponding to seven human years.

Anteroposterior facial growth provides increased extent of the dental arch. Miss Tracy has also shown that, in a general way, the maximums of velocity and extent of growth correspond with development, not actual eruption, of the teeth. The maximums therefore occur before, not after, tooth eruption. These maximums are found during the first six months after birth (development of deciduous dentition), between 4 and 7 years (development of first and beginning of second molars), and between 15 and 19 years (third molar).

In considering facial growth in vertical forward projection of the face beyond the cranium.

In discussing extension of the dental arch, there are obviously two loci of special activity, that about the cuspid tooth and that in which the permanent molars are set. In man, the latter is the more important. As this locus lies directly under the anterior part of the cranium, it can expand only as much as anterior extension of the cranium permits, unless there is a readjustment within the maxilla itself. The cuspid locus is not under the same restriction. Forward extension may take place without concomitant

cranial growth: the readjustment can occur at the premaxillomaxillary suture.

The sutures are the indicators of growth and readjustment. As long as a suture is patent, these phenomena can occur. After closure, or in areas where sutures do not occur, growth and readjustment can take place only by the discredited process of interstitial change.

Miss Perrine has shown that in baboons, anteroposterior palatal growth takes place on the maxillary sides of the premaxillomaxillary and maxillopalatal sutures. It is a striking fact that the premaxillomaxillary suture closes in early infancy in man, in whom cuspid extension is not a significant phenomenon, but remains patent until early adult life in the animals which have tusklike upper permanent cuspids. It also remains open in sheep, which have none. This is an example of lapsed union associated undoubtedly with some constitutional condition of which we know nothing. Lapsed union, in a partial degree, is found characteristically in the facial and cranial sutures of man. I have discussed this phenomenon on other occasions.

It is convenient to refer to face and palate together as the mask. The skull sutures are therefore classified as cranial, mask and hafting.

PHENOMENA OF SKULL GROWTH IN LOWER MAMMALS

The hyena, as studied by Schweikher, affords an example of relatively simple skull growth. Figure 2 illustrates the features very clearly. The half-grown skull is superposed on the adult so that both are arranged in the Frankfort plane; that is to say, the upper border of the ear hole (porion) and lower border of the orbit (orbitale) are oriented in a horizontal plane. In Figure 2, above, the poria being superposed, it is clear that there is little extension back of the ear hole, but much in front and above. In Figure 2, center, the anteroposterior growth is analyzed. It is apparent that there is considerable growth between cranium and face (the hafting line), and again at the premaxillomaxillary junction for the development of the huge permanent cuspid. In Figure 2, below, the analysis is carried a step far-

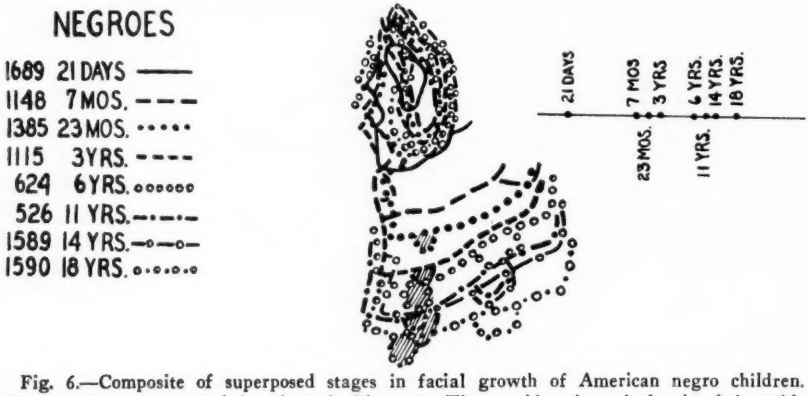

Fig. 6.—Composite of superposed stages in facial growth of American negro children. (Tracy.) Arrangement of data is as in Figure 3. The cuspid and vertical axis of the orbit remain virtually unchanged throughout growth owing to the fact that the cranium and the face extend forward at the same rate and in equal amounts.

ther, so that separate bones are superposed. This demonstrates the opening of the anterior cranium to provide a larger hafting basis for the face. It also shows the detailed features of facial growth, which takes place largely in the upper facial or respiratory area. The hyena skull is already stabilized in the posterior part of the dental area at the half-grown stage, when the great carnassial or last premolar tooth is developed. Anteroposterior facial growth is especially accentuated around the cuspid. Owing to frontal expansion of the cranium, a as it were, at the frontonasal suture (nasion). This gives rise to the swollen appearance of the sheep face. Space is gained at the back of the dental arch for the molars by the forward frontal expansion carrying the mask with it.

The same forward frontal expansion is shown by Cooke to characterize the pig skull. For this purpose, Cooke took an especially long-snouted species of pig from Borneo known as *Sus barbatus*. His researches demonstrate that, in the half-grown animal, there is the same downward buckling of mask on the na-

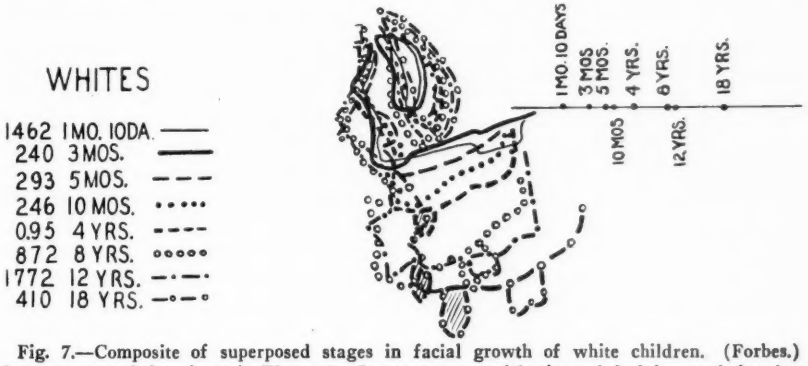

Fig. 7.—Composite of superposed stages in facial growth of white children. (Forbes.) Arrangement of data is as in Figure 3. In consequence of horizontal facial growth lagging behind that of the cranium, both cuspid and "vertical" orbital axis are progressively displaced backward.

growth taking place in the olfactory area rather than in the brain-case itself, there is no bias given to anteroposterior facial growth and the extension of the face travels forward along a horizontal plane.

By his observations on skull growth in the sheep, Wharton demonstrates the same general features which were clarified by Schweikher, but, in the absence of the upper cuspid and incisors, the front part of the mask has not the marked growth of the hyena, and, in the course of later postnatal development, the front of the face buckles downward, sion as in the sheep. But with the development of the huge upper cuspid tusk, further anterior facial space is needed at a date when the mask, hafting and cranial sutures are already stabilized and partially closed. Hence, an upward torsion is given, in later growth, to the anterior part of the face. This gives the characteristic upper concavity to the silhouette of the pig's face as seen from the side, and even the anteroposterior plane of the palate becomes convex downward.

From these combined investigations, we learn that if forward extension of

cranial and facial skeletons is compensatory, as in the hyena, anteroposterior facial extension proceeds in a horizontal line. If the facial extension is relatively small, there is a downward buckling at the nasion as in the sheep. If, after this stabilization of skull form, more anterior space is needed in the face, the snout region buckles upward as in the pig.

FACIAL DEVELOPMENT IN ANTHROPOIDS

The very elaborate study of growth in the anthropoid skull, made by Krogman, and published in the *American Journal of Anatomy,* gives us a mine of useful information on our subject. I shall utilize, in this report, the figures he has presented on gorilla growth, though the superpositions will be oriented in a manner modified by our special needs.

Bowman has shown that growth of the human orbit occurs early in life and is practically complete at about the age of 4 years. In subsequent observations recorded here, whether of anthropoids or of man, the orientation follows Krogman's general principles but is modified to suit our special purpose. As he directs, we draw a horizontal line and arrange upon it the poria (upper borders of ear holes) but superpose nasia (frontonasal points) upon each other during the period of orbital growth. This demonstrates excellently the growth of the orbit, at first concentric and then in its lower part only. After the date in development which corresponds with approximately four human years, we substitute a superposition of the upper orbital margins for that of the nasia, keeping the poria adjusted upon a horizontal line. Any vertical growth of the orbit hereafter is an accessory of upper facial growth and is not brought about by concentric orbital enlargement. By both these methods of superposition of skulls showing successive stages in growth, the distance between the poria on the horizontal line gives a measure of anteroposterior extension of the cranium in front of the ear holes. Should coronal sutures be superposed, the growth must be on the parietal side of the suture, but if the coronal sutures are not superposed, the extension is in the frontal bone.

In the early postnatal growth of the gorilla, anterior cranial expansion is in the parietal region, but from the date corresponding to about five human years, the gorilla skull expands in the frontal bones mostly by extension of the penthouses for the eyeballs of which the roof is formed by the relatively enormous supra-orbital ridges of the animal.

The vertical growth of face is largely "respiratory" and sexual and may be dismissed without further comment. But Figure 3 shows graphically how the forward cranial (parietal) extension, which is obvious until the animal has reached the five-year human stage, carries the face forward so that the deciduous cuspid maintains its position relative to the skull as a whole. Then, growth of the brain-case having slowed down almost to nothing, the face grows forward alone, pulling out the supra-orbital ridges with it and extending the muzzle to provide for the huge permanent cuspids. This extension has practically ceased by the time the animal has reached that stage in development characteristic of man at 12 years, and thereafter the cuspid again stabilizes its relation to the entire skull. The creeping forward of the cheek teeth is well shown by change in position of the first permanent molar.

In the orang-outang brain case (Fig. 4) expansion in the frontal bone practically ceases at about the stage of development corresponding to two human years, but parietal extension occurs till about seven human years, when that also

ceases, and the marked facial extension, occurring thereafter, does not pull forward the supra-orbital ridges to form penthouses. The face, in its extension, therefore buckles upward on the nasion as in the pig. And once again, as in that animal, the anteroposterior contour of the palate becomes convex downward. In the later stages also, the lower part of orbit is carried forward by the independent facial extension.

In the chimpanzee (Fig. 5), there is quite a different tempo of cranial growth. Extension of the brain case takes place in the parietal region to a very limited degree. The cranial extension is almost wholly located in the frontal bone, but there is much greater growth just in front of the coronal suture than in the gorilla. Facial extension does not therefore pull forward the supra-orbital ridges so much as in that animal. The frontal extension is reflected in the gradual forward modification of the cuspid in relation to the skull. Only after the stage corresponding to seven human years does facial extension outrun the frontal projection.

It is worthy of note that the "vertical" axis of the orbit betrays the forward extension of the lower face after stabilization of the upper face. This is pronounced only in the later growth phases of the orang-outang.

ANTEROPOSTERIOR FACIAL GROWTH IN MAN

After this constructive survey of facial growth in lower mammals and in anthropoids, we reach certain quite definite and very simple conclusions. Admitting to immediate attention only the anteroposterior dimension, we have noted that facial growth has two loci of activity: the one about the cuspid, the other about the permanent molars or posterior end of the dental arch. The hyena differs from all the other animals that we have considered by attaining stabilization of the posterior end of the arch comparatively early in life. Its cuspid stabilization, like that of the pig and anthropoids, occurs much later. The development of the pig's cuspid tusk, after the relations of face and cranium are set, is associated with a facial buckling upward on the nasion so that the anteroposterior contour of the palate becomes convex below. We have also seen that the face is carried forward with the anterior part of the cranium as long as frontal projection is active. Thereafter, it moves forward alone.

In the anthropoids, we can clearly differentiate these two phases of forwardly directed facial extension. As long as the cranial extension is vigorous, passive facial projection is registered by a constant relationship of cuspid to skull. But when facial projection outruns cranial extension, the cuspid moves forward with the protruding jaw. In the gorilla and the orang-outang, forward cranial extension ceases at a stage of development corresponding to about six human years. The actual cessation in the gorilla at the fifth and in the orang-outang at the seventh human year in our particular series is probably accidental. From the sixth to approximately the twelfth human year, in these animals, facial projection outruns cranial extension and the difference is registered by the movement forward of the cuspid. Thereafter, stabilization of the anterior palate takes place. The chimpanzee really registers the same phenomena, but they are not so obvious. Further, the precise features in both gorilla and chimpanzee are obscured by the development on the frontal bone of large penthouses for protection of the eyeballs.

Wiping out the idiosyncrasies of

growth in the three great anthropoids, we get certain plain facts. Forward facial extension is partly passive and partly active. The distinction between the two is registered by the cuspid, which maintains a stationary relationship to the skull as long as facial extension is passive, but moves forward with active forward growth of the face itself. It is this active forward facial growth which is the true prognathism.

Passing to consideration of horizontal facial growth in man, we expect to find modification of the anthropoid growth pattern along with the small cuspid. We also expect to find a modification attributable to the enhanced cranial growth of man which follows the relatively great brain development. Indeed, the first indication of this differentiation is the fact that the parietal underpinning now includes the greater wing of the sphenoid in addition to the squamous temporal bone. In the great anthropoids, the greater wing of the sphenoid has ordinarily no articulation with the parietal bone except in the orang-outang, in which there is mere contact of the two bones but no full articulation as in man. The human trait, as distinguished from the anthropoid, of an expanding of the cranial base, particularly represented by growth in the great wing of the sphenoid, shows little further extension after eight years. Until this date, we must be prepared for an expanding cranial base in consequence of which the nasion-porion distance and nasion-sella distance will progressively increase, especially at the age of about 4 years to 7 years. There is some evidence in the work of Miss Tracy and Miss Forbes that the basal expansion is rather greater in negroes than in whites, but this observation needs further investigation before a final conclusion is reached. It is quite possible that there is a difference in the mechanical details of anterior cranial expansion of the two races. As far as forward cranial extension is concerned, there is no real racial distinction. We find in both whites and negroes, a forward growth of cranium so great that it equals or outruns the facial projection.

Turning our attention first to American negroes: Figure 6 shows a stable position of the cuspid and of the orbital vertical axis throughout the growth period from eruption of the deciduous cuspid as far as adulthood. This means, of course, entire absence of independent facial extension. There is no true prognathism in the American negro, but face and cranium maintain an equal place in horizontal forward growth. The creeping of the first molar is also clearly seen in Figure 6.

The composite picture of facial growth in white children (Figure 7) shows a quite remarkable distinction. The cuspid does not maintain its position relative to the skull. It moves erratically backward as though the forward growth of the cranium outdistances that of the face, especially during the second decade. I would not draw your attention to it, at the present stage of our investigations, as anything more than an irregularity occurring in whites. The frequency and degree of this growth disharmony must be inquired into. That such a tendency exists is clearly shown by the increasing obliquity of the "vertical" orbital axis, of which the upper extremity inclines ever more forward and the lower, backward, as the child increases in age. There is no escape from the inference that disharmony is present in facial and cranial growth of white children, and that this may well be one of the conditions predisposing to the need for orthodontic treatment.

SUMMARY

1. The directions of facial growth are horizontally forward, vertical and transverse.

2. In addition to active growth in the face itself, forward cranial extension carries the face passively forward.

3. In anteroposterior growth of the upper jaw, there are two loci of activity, the anterior about the canine and the premaxillomaxillary suture, the other about the permanent molar teeth or posterior part of the dental arch.

4. Patent sutures, whether of cranium or of face, are indicators of growth and adjustment. With closure of sutures, stabilization occurs.

5. In the simpler facial growth of lower mammals there is some passive forward movement of the face owing to frontal expansion which may be largely the result of growth at the frontonasal suture, but partly also at the coronal. This passive extension provides for accommodation of molars in the extending dental arch.

6. Cuspid accommodation is provided by facial growth independently of cranial growth. In the pig and the orang-outang, which are characterized by growth of the cuspid after the intrinsic cranial and facial features are set, there actually develops a "buckling" of the face on the nasion and a downwardly directed anteroposterior convexity of the palate.

7. The problem of human facial growth is complicated, first, by the relatively huge cranial expansion and, secondly, by the absence of any marked anterior facial growth pattern around the cuspid. The indicator of the latter feature is the closure in infancy of the premaxillomaxillary suture.

8. In American negroes, there is equality in pace of forward extension in cranium and face. Consequently, the cuspid maintains a constant relationship to the skull throughout the period of growth. The orbital axis also remains constant.

9. In whites, on the other hand, facial growth lags behind cranial. The orbital axis progressively and materially alters since the upper orbit moves forward with the cranium, while the lower orbit lags behind with the face. The position of the cuspid likewise changes. How far these features are characteristic of white stock is a matter for future investigation. There may be conditions which increase or diminish the lag.

10. Consideration of Class 3 malocclusion is incomplete if attention is given to the mandible alone. Admitting that many instances of malocclusion are caused by defects in developmental growth of the lower jaw, it is essential that the maxilla also be carefully surveyed in order that any possible imperfect growth or maldevelopment in that part of the face be not overlooked in prescribing treatment for the case.

PRACTICAL APPLICATIONS

1. A knowledge of the comparative anatomy of skull growth throws into clear distinction the special features characteristic of man.

2. These special features are two. Huge expansion of the brain case causes enlargement of the cranial base with a progressive increase in nasion-sella dimension between birth and 8 years, probably greatest from 4 to 7 years. Secondly, there is no true prognathism in man because he has no vigorous anterior locus of facial growth about the cuspid.

3. In American negroes, the forward pace of growth in cranium and face is the same, but in whites, there is a tendency for facial extension to lag behind cranial. We do not yet know the condi-

tions which influence this very significant phenomenon. It is clear that defective growth of the dental arch, whether anteroposterior or transverse, will call for orthodontic attention.

4. Norms of facial growth in white children, carefully constructed and related to the features of cranial growth, will have to be sought in numerous case studies.

5. The influence of various conditions which possibly modify facial growth requires further close attention. For example, we do recognize the small pinched face of chronic gastro-intestinal disorder. The face lags so far behind the cranium that the forehead becomes prominent, nose outstanding and chin "retracted." We do not know how the growth pattern may change when proper health habits are established.

6. There is only one way to appraise correctly the facial development picture of any child; namely, by fitting this picture into his own facial growth pattern. Dr. Broadbent has shown just how we set about this difficult procedure in Cleveland. It is not the only possible method, and details may be changed as circumstances require. The principles are sound and must be followed if we are to meet with success.

SURGICAL PREPARATION PRIOR TO DENTURE CONSTRUCTION*

By OATHER A. KELLY, D.D.S., St. Louis, Mo.

OPINIONS relative to the treatment of the mouth before the insertion of dentures have changed in the last fifty years. As late as 1886, articles appeared in the leading dental journals advising the retention of all roots possible in order to stabilize the ridges. Teeth with carious crowns were ground to the gum margin and left in the alveolus.

This practice is contrary to what we follow today, as we believe that not only should all roots be removed, but, in addition, all diseased tissue found in the periapical region and about the gingival regions.

Since infection is the cause of the loss of most teeth, and as it does not progress to the same extent around each tooth in a given time, it is found that after extraction, the alveolar process is left in a roughened condition. For instance, the process around the second bicuspid may be destroyed almost to the apex; around the first bicuspid, only to the middle third, and, around the first molar, to the gingival third. Obviously, a denture placed over a harsh bony base of this character will cause irritation to the overlying soft tissue. If the base is not disturbed, Nature will make an effort to smooth it down. In this effort, there is only partial success, and the time required to make the base tolerate a denture with any degree of comfort is considerable.

The employment of surgical means can overcome this roughness of the alveolar ridge and reduce the time necessary for

*Read before the American Full Denture Society, Memphis, Tenn., Oct. 16, 1931.

a patient to wait before dentures are inserted. In addition, surgical procedure can eliminate several other unfavorable conditions occasionally found in the mouth and which militate against the endeavors of both patient and dentist in the replacement of the teeth.

Any operative procedure, to be successful, must be predicated upon a complete diagnosis of the existing conditions, and the training and experience of the operator. In treating mouths for the reception of dentures, it has been found imperative to have a complete roentgenray examination and, in the majority of cases, study casts. The advice and suggestions of the dentist who is going to construct the denture is sought before the patient is operated on. He should be furnished with the roentgenograms and the surgeon's report, and have an opportunity to examine the patient in order to secure data which will be an aid in the construction of the denture, such as the actual registration of the relationship of the mandible to the maxilla.

Surgical treatment in this instance implies that all the cardinal principles of modern surgery shall be followed, such as asepsis, respect for living tissue and appreciation of the index of resistance and the possibilities of creating deformities. It is the practice to expose the field of operation to direct vision. In other words, the bony base is exposed sufficiently by a retraction of the mucoperiosteum that the operator can see clearly whatever excision is to be made.

A mouth with a smooth bony base, healthy tissue, normal muscular attachments, no excessive soft tissue and no conflicting undercuts is considered a favorable one for the reception of a denture. A picture of such a condition is kept in mind in removing teeth. An improvement can be made by surgical measures in any mouth from which teeth have been removed. For this reason, the open-view method is employed routinely on patients who are to wear dentures, regardless of the simplicity of the extractions. The procedure calls for a mucoperiosteal reflection to a point above the apices of the teeth to be removed. In the case of complete extraction of the teeth from the upper jaw, an incision from tuberosity to tuberosity is made through the gum septums on the buccal aspect and the tissue elevated without vertical incisions. It can be determined whether excision of the process is necessary to facilitate the removal of any of the teeth. If this is necessary, it is done and all the teeth are removed. The palatal tissue is then reflected, the process beginning at the margin of the incised septum. Usually all the granulation tissue that is in the pyorrheal pockets is reflected with the palatal tissue. The condition of the alveolar process is then closely scrutinized. A control point is established on both the right and the left side and in the anterior region, to prevent the possibility of shortening the ridge too much. The ridge is then contoured to the most favorable shape by means of rongeurs, files and chisels. The field is swept clear with gauze sponges moistened in saline solution and each socket inspected. Any diseased tissue found in the pockets is removed with curettes. The flaps are brought in position and the surplus is excised. A sufficient number of sutures are inserted to hold the flaps in position. The advantage of excising the excess soft tissue at this time lies in the fact that the freshly cut edges will unite more rapidly and the opportunity of bacterial contamination will be diminished as that portion of the tissue which has been open the longest is removed.

There are dentists who still attempt to

build dentures around abnormalities that can be eliminated. Many patients carry hideous protruding teeth for years after these teeth should have been removed because of advice that a successful replacement was impossible. In the more severe cases of alveolar protrusion of the maxilla, the excision can be carried much farther than is generally believed possible. The anterior palatine canal need not limit the extent of the excision. Its direction is always the same as that of the protrusion, and the bone can be excised about the foramen. The location of the foramen is merely changed.

Tubercles are often encountered to the lingual aspect of lower cuspids and bicuspids. These eminences have been found to be more dense than other osseous structure about the mouth and the excision more difficult. The external surface is glazed, with the periosteum fully movable. It is practically impossible to obtain a peripheral seal of a denture when lingual tubercles are found in a mouth unless they are excised.

Bony tumors in the median line of the palate or congenital osseous excrescences are occasionally of such size and outline that a denture cannot be constructed over them. One must differentiate between an actual tumor in this region and a deflection of the palatal process from the floor of the nose. This may be done by using a trephin to gage the thickness of the bone.

When muscles are found to have an attachment in an abnormal position or in a position which will mean the unseating of the denture when it is brought into function, the attachment is cut, a section of the tissue removed and a more favorable reattachment established.

Enlarged tuberosities are of three types. One type consists of a dense fibrous mass of tissue attached to the tuberosity by a definite pedicle. These are merely excised. In another type, the tuberosity itself is abnormally large, with the soft tissue stretched tightly over it. An incision is made through the soft tissue and the bony tissue planed down to the size desired. In the third type, the floor of the maxillary sinus is lower than normal and extends back to the heel of the arch. The sinus has apparently expanded and only a thin shell of bone with tightly stretched tissue separates it from the oral cavity. Where necessary, the tissue is reflected from over the thin bone and the outer wall removed, which permits the curtain to fall back straight. This has the same effect as collapsing a cavity. The excess soft tissue is then excised and the line of incision tightly sutured.

The evidence presented by a large number of roentgenograms indicates that, frequently, an expansion of the maxillary sinus occurs in patients who fail to have a replacement made of missing bicuspids and molars.

KNIFE EDGE RIDGES

Many patients who have attempted for years to become accustomed to their dentures and have had nothing but discomfort are found to have a knife edge ridge, which frequently is covered with rather heavy and normal tissue. In this type of case, the mucoperiosteum is reflected and the bony base exposed. This thin knife edge osseous structure occasionally extends the entire length of the arch. It is excised completely. What has been an unfavorable mouth for a denture is quickly and easily converted into a favorable one.

Cystic conditions are frequently found in edentulous mouths and the treatment is the complete enucleation of the cystic membrane. Drainage is apparently of no avail. To collapse the resultant cavity

would ofttimes impair the contour of the arch. In this type of case, the cavity is packed lightly with iodoform gauze, which is changed every four or five days, the amount used gradually diminishing until the cavity is filled in.

A denture should not be inserted over impacted or unerupted teeth. Such teeth should be removed first. In a number of cases observed, a chronic inflammatory process was present in the tissue, having been incited by a denture being worn over an unerupted tooth. Some of these patients had been convinced that a cancer of the mouth was present and had suffered mental agony for years in the belief that their malady was incurable.

Ridges covered by thin tissue are relieved in the following manner. The mucoperiosteum is reflected and the bone examined. If no sharp points are present in the bony base, the flap is dropped back in place. Two other incisions are made parallel with the initial one toward the lingual and buccal aspects. This makes three cuts and two strips. The edges of the wound are separated and blood is permitted to clot in the three lines of incision. New tissues will granulate in the site of incisions.

Hyperplastic proliferation of tissue underneath a denture may occur if the denture is ill fitting or the bony base is rough. This condition is often found in a patient who is wearing a full upper denture with the lower anterior teeth remaining. The tissue develops on the palatal flap from cuspid to cuspid. It is very thick, fatty underneath the mucous membrane and movable. This tissue should be excised, being cut off on a bias from the underneath surface. The labial and the palatal flap may then be brought in coaptation and attached to each other.

A patient with a chronic opening from the oral cavity into the maxillary sinus cannot obtain satisfactory function from dentures. The opening must be closed. It need not be large to cause failure of the denture, and, in some instances, it is difficult to locate the opening.

It is the surgeor's obligation to remove all root fragments and residual areas of infection which are either actual or potential sources of sepsis.

The attitude of the patient toward surgical preparation of the mouth for dentures, particularly alveolectomy, is almost always favorable when the benefits are presented. That it is a safe and conservative method has been demonstrated by the number of patients cared for.

The attitude of the dentist may be one of indifference, opposition or enthusiasm. It is predicted that the indifferent will eventually realize the wisdom of the improved methods, and those who are now opposed to the procedure will become enthusiastic as soon as their experience is sufficient to justify an opinion.

It is fortunate from a health standpoint that we do not now have to depend on infected roots to stabilize the dental ridges, but instead, by inserting dentures quickly over healthy tissue, a physiologic stimulation is furnished to the matrix and repair rapidly follows. Atrophy of the ridges does not ensue. Instead, a mouth will remain relatively the same shape and size for years.

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Editorials

THE CHRISTMAS SEALS

If there is one thrill in life more appealing or ennobling than another, it comes from the consciousness of lending succor to the needy and relief to those who are suffering.

Some years ago, a few of our men of vision inaugurated a movement to raise a fund the interest on which should help to care for those of our failing and worthy members who, through the buffets of fate, were unable to support themselves.

A relief committee was appointed for the purpose of raising money to augment this fund, and a relief commission for the purpose of dispensing the proceeds to those in need. This effort has already provided the means whereby eighty-four men have been given relief, and an appreciable number of them have been men who, without this support, would have been obliged to go to the poor house. How would the rank and file of our members feel today if they were made to realize that any of their fellow mem-

bers were living in the poor house after contributing to the support of the organization when they were in their prime?

It is conservative to say that no single enterprise in our Association has made a more profound appeal than has the relief movement, and the interest is growing from year to year.

The sole means of increasing the relief fund is through the medium of voluntary contributions and particularly of distributing Christmas Seals to our members, and each year an effort is made to augment the fund in this way. The members have responded nobly in the past, but of a surety the response would have been much greater had the membership generally been fully aware of the character and extent of the relief given.

At this particular time, when the period of financial stress has grown so burdensome to many, the need for relief has become more than ever pressing. Every man and woman of the whole Association should contribute this year, if at all possible, for the very patent reason that the need for relief will be greater than ever. Even if good times are in the offing, as we all hope, the aftermath of the recent period of maladjustment will leave many of our ageing and ailing members in dire need of relief, and we must, in common humanity, see that they are cared for. To do less than this would be to fail in a very fundamental duty and to reflect on the good name of our Association. In an enterprise as fundamentally right, equitable and pressing as this, there can be no wavering, and not a moment's hesitation.

When the seals come in, "Stop, look and listen." Stop long enough to send in the dollar; look at the amount of good that is constantly being done and that must be done in the future; listen to the cry of the needy in our ranks, the cry that comes not from the outside world, but from our very own, the brotherhood of the Association that means so much to every one of us. Send in the dollar for the seals this year, even if you have never done so before. Christmas will mean so much more if it is sweetened and chastened with the beneficence of even so small a gift as this one dollar. The essence of charity is not so much in the amount of the contribution as it is in the spirit, the cheerfulness and the spontaneity of the offering.

Let us make ourselves happy by making others happy.

A MISSING LINK

It would be well if there were some way whereby a closer link could be welded between the students of medicine and dentistry in our professional schools, as well as between the students and the various agencies having to do with the welfare of children even as early as preschool age. We are all aware of the significance of early attention to the teeth of young children, and much of the prevalent neglect of children in this regard might be obviated if there were closer cooperation between physicians, dentists, nurses, dental hygienists and dental assistants. In fact, every one coming in contact with children should be schooled in the necessity for early attention to the teeth, with the idea that only by taking care of the children can we hope to bring about prevention of dental disease. A little early care means more than a great deal of subsequent care, and this fact should be borne home to parents through every agency possible.

The physician needs to know it, the nurse needs to know it and to be impressed with it, the teacher and welfare worker need to know it, and it should be one of the first things taught to students of medicine and dentistry. If it were possible to have a joint course for medical and dental students, it would be an excellent thing; but, where this is impracticable, there should at least be a separate course in every institution wherein children's dentistry would receive special attention.

Of course, the most important thing of all is to bring the necessary information into the home, where those who have the daily care of young children may be made to realize the importance of periodic inspection of the teeth, to the end that toothache is never allowed to enter the domestic circle. It will require every agency at our command to bring this about. Before we can hope to impress the parents and gain their cooperation, we must first impress the members of our professional bodies individually and collectively with the essential importance of this service. Instruction in our medical and dental schools should be of a character to carry conviction to every student, to the end that,

when he goes out after graduation, he will be imbued with the necessary enthusiasm to carry out in practice what he has learned in college.

In line with this idea, a committee was appointed in 1927 from the American Association of Dental Schools on "preschool age dental clinics and the cooperation of medical, dental and nursing professions," with the purpose of forming plans for consummating such a movement among the dental schools of the association. The members of this committee are Frank A. Delabarre, C. L. Drain and G. K. Thomson, chairman.

A NEGLECTED ROOT-FILLING

Years ago, we occasionally saw reference made to oxychlorid of zinc as a root filling, but now we seldom see it mentioned. Doubtless the reason for this is the fact that it was a difficult material to carry to the root end. In some of the smaller canals, it was manifestly almost impossible to fill to the apex, and thus other materials, such as guttapercha, were introduced, to the almost complete exclusion of oxychlorid of zinc.

But this material had one supreme virtue that placed it in a class by itself as a canal filling, and it should never have been wholly discarded as it was. Oxychlorid of zinc is one of the best barriers to bacteria that were ever introduced in a canal, and this virtue should not be ignored in a root filling. The obvious procedure is to utilize in the fine ends of canals some material such as guttapercha, and to cover this in every instance with oxychlorid of zinc in the pulp chamber or larger portions of the canals where it may be readily introduced. To protect the canals in this way by an impervious material such as oxychlorid of zinc is to leave the canal more wholesome, and minus the odor that sometimes accompanies the insertion of guttapercha after it has been in the canal for some time. It is doubtful that there would ever have developed the prejudice against root filling which we have sometimes seen had there been a general use of oxychlorid of zinc for this purpose.

It is needless to say that this material is not indicated as a tem-

porary filling material in the manner that oxyphosphate of zinc is sometimes used, to tide over a very sensitive cavity till the sensitiveness is relieved and a metal filling is inserted. Oxychlorid of zinc is not usually stable when subjected to the fluids of the mouth and will ordinarily not last so long as will oxyphosphate of zinc under these conditions. But when protected as it is in a pulp chamber or canal, it is one of the most satisfactory materials that can be used and it should be employed in every case of a pulpless tooth.

"PAINLESS" PARKER DECISION

Last minute information has just reached the Editorial Office from Homer C. Brown, chairman of the Committee on Legislation and Correlation, to the effect that an important decision has been handed down by the Supreme Court of California in the "Painless" Parker litigation. According to Dr. Brown: "The majority decision of five members of the court, affirming the Judgment of the Superior Court, covers ten pages, and there is a dissenting opinion, by one member, of more than seven pages."

Dr. Brown further comments: "This is probably the most important decision relating to the practice of dentistry ever rendered by a supreme court."

Accordingly, the members of the American Dental Association are hereby advised of this decision, which must be most gratifying in every particular. To those who were largely instrumental in bringing this matter to a final issue, the deepest obligation is due from the profession and the people at large.

SIT TIGHT

In every great emergency of life, the logical thing to do is to sit tight. Emergencies come to most people at one time or another, and to some people they seem to come with discouraging frequency; but no matter in what guise they come or how frequently, the way

to meet them is to sit tight till the emergency passes. For usually it does pass, and the degree of damage done by it is ordinarily measured almost wholly by the extent to which the individual yields to the situation or tries to recede from it. To meet an emergency more than half way the moment it is seen approaching, and to sit tight in the face of it, is usually to overcome it; but to become unstrung and filled with panic is to magnify the emergency and make it seem more real than it actually is. During the depression, the man who has gone along in the even tenor of his way as nearly as it was possible for him to do so; who has said as little as need be about the terrible times; who has husbanded his resources to the best of his ability, and who has smiled even when he was "taking it on the chin"—this man has done more to meet the emergency and hold the ship on an even keel than all the spectacular prophets or all the wise economists who have been telling us so learnedly what we should do to be saved. Just sitting tight is sometimes a wonderful achievement.

WILLIAM CUMMINS FISHER, D.D.S.

(1876-1932)

William Cummins Fisher was born in Washington, D. C., July 14, 1876; died at Bronxville, N. Y., Oct. 14, 1932. He was the son of Henry Fisher, of Washington, and Mary Snyder Fisher, formerly of Baltimore.

His early education was obtained in the Washington schools, and he received the degree of D.D.S. from George Washington University Dental University in 1899, continuing his professional education at Magill University, Toronto, Canada and the University of Dublin, Dublin, Ireland.

Dr. Fisher practiced dentistry in London, England, returning to the United States where he passed a competitive examination for an appointment as dental surgeon in the regular army. He served from August, 1901, to July, 1904. Upon resigning from the Army dental service, he came to New York, where he was in practice until his death. He was a member of the American Dental Association, the American Medical Association, New York State Dental Society, First District Dental Society of New York City, and the Institute of Dental Technique of New York. He was a former president of the Institute of Dental Technique.

Dr. Fisher was appointed a major in the Dental Corps of the U. S. Army, Nov. 8, 1918, and was honorably discharged April 29, 1919. He was appointed

WILLIAM CUMMINS FISHER, D.D.S.
(1876-1932)

a lieutenant colonel in the Dental Reserve Corps in 1919 and colonel in 1923. He was a past president and honorary member of the Association of Military Dental Surgeons.

Dr. Fisher was a member of the American Society of Orthodonists, a founder of the New York Society of Orthodontists, of which he was at one time secretary-treasurer and later president.

Dr. Fisher was made president general of the First International Orthodontic Congress, for which he wrote the constitution and by-laws and outlined a plan of organization and operation. He was active in the Ninth District Dental Society of New York, of which he was a past president. He was president of the New York State Dental Society in 1930, and was also a member of the European Orthodontilogical Society, the Southwestern Society of Orthodontists and an honorary member of the Southern Society of Orthodontists.

FERNANDO E. RODRIGUEZ, B.S., D.D.S.

(1888-1932)

Fernando E. Rodriguez, a major in the Dental Corps of the U. S. Army, died at Walter Reed Hospital, Washington, D. C., Oct. 21, 1932.

Major Rodriguez was born in Puerto Rico, Feb. 24, 1888. He obtained his degree in dentistry at Georgetown University, Washington, D. C., and, after a short period of practice in that city, he entered the United States Indian Medical Service and made a study of dental conditions among the Indians of the Southwest. During this service, he made an important contribution to the study of mottled enamel.

He entered the Army as first lieutenant in 1917, served at several stations in the United States and was on duty in Puerto Rico from August, 1919, to February, 1921, when he was assigned to the Army Medical School, Washington, D. C., as student and investigator in the bacteriology of dental diseases. He made rapid and unusual progress. As early as December, 1922, he published an original and fundamental work on the specific bacteriology of dental caries. He made other contributions to the field of bacteriology, such as the development of technics and otherwise, and gained national prominence as a scientist. He was a member of the International Society for Dental Research and Fellow of the American College of Dentists.

Major Rodriguez is survived by his widow, Marianita P., and a 10-year-old son, Robert.

Rex H. Rhoades,
U. S. Dental Corps.

COUNCIL ON DENTAL THERAPEUTICS

SENSITEX—NOT ACCEPTABLE FOR A. D. R.

Two reports on Sensitex follow. The first report, holding the product unacceptable, and detailing the chemical examination, was withheld from publication because a representative of the firm presented a statement that Sensitex contained 16+ per cent hydrous aluminum chlorid. Reexamination of specimens of Sensitex was carried out with samples purchased in three different parts of the country. The results of the second examination indicated no essential grounds for revision of the conclusions of the first report. Both reports are presented for the information of the profession.

SAMUEL M. GORDON, *Secretary*.

For some time past, inquiries have been received concerning Sensitex, manufactured by Dr. J. M. Rosenthal and marketed and "guaranteed" by King's Specialty Co., Fort Wayne, Ind.

The preparation was deemed of sufficient interest to warrant examination in the A.D.A. Bureau of Chemistry, because a statement of composition did not appear on the label and because dentists were asked to pay $2.50 for a small bottle of the product. While the examination was being conducted, a communication was sent to the King's Specialty Co., asking whether the composition of the preparation was secret. If not, they were asked to furnish a statement of the qualitative and quantitative composition.

After some time, the firm wrote in part as follows:

> Referring further to your communication of May 10th which concerns Sensitex, we wish to explain that while the composition of this preparation is not entirely secret, yet we feel that it would be an injury to us as well as to the profession to publish the exact formula. Dentists would not try to make it but there would be plenty of danger that other manufacturers would make the effort and perhaps at a rather serious cost to the profession.
>
> Sensitex is a chloride of metals; sodium, magnesium, zinc, potassium, aluminum, calcium, aluminum oxide, and triple distilled water. By refiltration, evaporation induced by heat, titration and testing, it is brought to conform exactly with a standard solution, Sensitex kept for that purpose.

The firm was informed that, according to the statements in their letter, the product was of secret composition and the position of the firm was at variance with the position of the dental profession that it is not only the right but also the duty of the dentist to know the composition of what he is asked to use or prescribe, and a request was made again for a statement of composition. Although a month has passed, the information has not been received.

The expression, "The Magic Wand" is used in advertising the product. Advertising carries the information that Sensitex is "chloralum-oxychloride," which it may be noted may refer to one of several products that may be formed by the

interaction of aluminum chlorid ($AlCl_3$) and water, and is noninforming as regards exact composition.

It is advertised: "For All Sensitive Tooth Surfaces," and is stated to be indicated for:

1. Chemical or mechanical abrasion.
2. Sensitive gingival areas.
3. Exposed roots, especially after surgical operations for pyorrhea.
4. After teeth are prepared for gold crown, three quarter crowns, or porcelain jacket crowns.
5. Hyper-sensitive teeth due to acid conditions of the mouth and to teeth rendered sensitive by prolonged illness.

Further suggestions and information are as follows:

6. Apply Sensitex to teeth which remain sensitive after being filled.
7. Use Sensitex on teeth rendered sensitive by carrying removable bridge work.
8. After grinding teeth to occlusion treat with Sensitex.
9. Sensitex applied to deciduous teeth will prevent caries.
10. Apply to teeth before setting regulating bands.

For all these conditions, it is directed that it be applied with cotton on a wooden applicator. Approximately one-fifth fluid ounce sells for $2.50. Reference to the report of the A.D.A. Bureau of Chemistry appended below shows that Sensitex is nothing more than approximately a 64 per cent by weight solution of zinc chlorid in water. The designation "chloralum-oxychloride" does not describe the preparation, and it is marketed with a therapeutically suggestive name. The firm's statement that "Sensitex is a chloride of metals; sodium, magnesium, zinc, potassium, aluminum, calcium, aluminum oxide and triple distilled water" would not enable a dentist to know exactly what he was using.

No adequate evidence is available that a solution of zinc chlorid, 64 per cent, is more efficacious in the conditions mentioned above than liquor zinci chloridi (containing about 50 per cent zinc chlorid), which is official in the U.S. Pharmacopeia X, or a few crystals of zinc chlorid dissolved in water at the chair, as suggested by some.

It can be readily appreciated that hypersensitiveness of the dentin despite the varying explanations of the cause, may be treated by either physical or chemical means, each of which has its indications. The medicaments used and belonging to the latter class are silver nitrate, or Howe's ammoniacal silver nitrate (this may be objectionable for anterior teeth because of the possibility of staining), zinc chlorid, alkalis such as sodium carbonate or sodium hydroxid, phenolic compounds, which act as protein precipitants in varying degrees, and local or general anesthetics, such as cocain, procain hydrochlorid, benzyl alcohol, eugenol or oil of cloves.

To rely on a product of secret composition sold at an exorbitantly high price is not rational nor desirable when there is readily available the same agent or other agents. Each case of hypersensitive dentin is an individual affair, and some cases do not require such caustic materials as zinc chlorid, but, if indicated, it should be used as such, and with full appreciation of its advantages, and disadvantages. The proprietors make no mention of the caution to be observed to prevent this strong solution of zinc chlorid from spreading and coming in contact with the soft tissues and to avoid pulp irritation. This is one of the precautions to be observed in the use of zinc chlorid for hypersensitive dentin.

The Council declares Sensitex not acceptable for A.D.R. because the composition is not frankly declared on the label (Rule 1); it is advertised with unwarranted therapeutic claims (Rule 6); it represents a simple solution of an official drug for which the Council cannot recognize a proprietary name (Rule 8).

The report of the A.D.A. Bureau of Chemistry follows:

SENSITEX

Three (3) original packages of Sensitex, price $2.50 each (manufactured by Dr. J. M. Rosenthal, guaranteed by King's Specialty Co., Fort Wayne, Ind.) were received for examination.

Each package consisted of a small bottle of colorless liquid, accompanied by a circular and enclosed in a carton.

The following appeared on the label:

Sensitex. Chloralum-oxychloride in a Specially Prepared Base. Apply to dried tooth surface with cotton wrapped wood applicator. (Do not use metal.) Allow application to remain about one minute, then rinse mouth with warm water.

Manufactured by Dr. J. M. Rosenthal. Guaranteed by Sole Agent, King's Specialty Co., Fort Wayne, Ind., U.S.A.

Each bottle contained approximately 6.5 c.c. (one-fifth fluid ounce) of a clear, colorless, odorless liquid, possessing an acrid, astringent taste. The specific gravity at 20 C. was 1.820. The liquid was acid to litmus and the p_H, determined colorimetrically, was found to be approximately 1.5.

Qualitative tests indicated the presence of zinc and chlorid. Aluminum, arsenic and other metals (excepting zinc), ammonium compounds, sulphate, phosphate, formaldehyd and organic substances were not found.

Quantitative examination yielded the following:

Sulphated ash	76.3 per cent
Zinc (Zn^{++})	30.8 per cent
Chlorid (Cl^-)	33.0 per cent

From the foregoing, it may be concluded that the essential composition of Sensitex may be expressed as follows:

Zinc chlorid ($ZnCl_2$)	64 per cent

Based on the foregoing, a solution having the essential composition of Sensitex may be prepared by dissolving 64 gm. of zinc chlorid, U.S.P. (fused) and 3.2 gm. of hydrochloric acid, U.S.P.,[1] in water to make 100 gm. (The specific gravity of such a solution at 20 C. was 1.816 and the p_H was approximately 1.5).

Quantitative determinations made on this solution yielded:

Zinc (Zn^{++})	30.8 per cent
Chlorid (Cl^-)	33.0 per cent

Based on current wholesale prices in one pound lots, the cost of ingredients for 6.5 gm. of such a solution would be approximately one cent.

SECOND EXAMINATION

The essential results of the foregoing report were transmitted to a represen-

1. Zinc chlorid, U.S.P., contains variable amounts of basic zinc chlorid (zinc oxychlorid), which remains as a granular white residue in concentrated solutions. By the careful addition of hydrochloric acid, a point is reached at which the precipitate just dissolves, and a clear solution results.

tative of the company who visited the A.D.A. Bureau of Chemistry. Shortly thereafter, a communication signed by the chemist for the King's Specialty Company was received stating that specimens of Sensitex examined by him contained aluminum to the amount of 16+ per cent as $AlCl_3 6H_2O$. In passing, it may be mentioned that reporting the amount of aluminum chlorid in the hydrous form gives a larger figure for the percentage of the compound present.

Accordingly, new specimens of Sensitex were purchased for reexamination in three different parts of the country. It was noted that the later specimens of Sensitex were cloudy. The firm was requested to state whether Sensitex is a clear solution or a turbid solution. In reply, the firm stated:

> . . . Sensitex in correct solution should stand clear. During March and April of this year, however, one particular batch became a turbid solution after bottling and cartoning and before the discovery was made as many as six or seven hundred bottles had been sent out. We were able to call in most of it to be exchanged for clear solution but some of it, of course, had been turned out by different supply houses and we were unable to find it.
>
> Clinical tests of this turbid solution showed absolutely no ill effect, therefore there was no harm done except to ourselves.

The report of the second chemical examination follows:

Three (3) original packages of Sensitex (manufactured by Dr. J. M. Rosenthal, guaranteed by King's Specialty Co., Ft. Wayne, Ind.) were received for examination.

Each package consisted of a small bottle of liquid, accompanied by a circular, enclosed in a carton. The cartons, circulars, bottles and labels were identical with those packages of Sensitex previously examined.

The following, in part, appeared on the labels:

> Sensitex. Chloralum-Oxychloride in a Specially Prepared Base.

Each bottle contained a colorless liquid with a gelatinous white sediment adhering to the bottom of the bottle. Shaking failed to dislodge the sediment. The liquids, on examination, were found to have an acid reaction to litmus.

Qualitative tests indicated the presence of zinc and chlorid; aluminum, calcium, magnesium sodium and silicious matter were indicated in small amounts. Potassium was not found.

Quantitative examinations yielded the following:

Sample No.	A	B	C
Volume of contents (c.c.)	5.8	6.0	6.6
Weight of 1 c.c. (gm.)	1.76	1.75	1.75
Sulphated ash (300 C.)	75.6	75.6	74.7
Zinc (Zn^{++})	30.0	30.5	30.2
Chlorid (Cl^{-})	32.8	32.7	32.3
"Silica"	0.51	0.25	0.27
Aluminum (Al^{+++})	0.16	0.11	0.07
Calcium (Ca^{++})	0.10	0.06	0.06
Magnesium (Mg^{++})	0.01	0.00	0.00
Sodium (Na^{+})	0.14	0.09	0.07

Using the figures obtained in the examination of specimen A, which was found to contain the largest amount of aluminum of the three specimens examined, it may be calculated that Sensitex is a solution containing aluminum chlorid ($AlCl_3$) 0.8 gm., calcium chlorid ($CaCl_2$) 0.3 gm., magnesium chlorid ($MgCl_2$) 0.04 gm., sodium chlorid (NaCl) 0.4 gm., zinc chlorid ($ZnCl_2$) 60.9 gm. with zinc oxid (ZnO) 1.4 gm., in water to make 100 gm.

From the foregoing, it may be concluded that a solution having the essential properties of Sensitex may be made by dissolving 64 parts by weight of zinc chlorid U.S.P. in water to make 100 parts by weight.

On the figures obtained in the examination of specimens B and C, similar conclusions may be based.

(End of Chemist's report)

From the chemist's report, it is apparent that Sensitex would have essentially the same therapeutic properties as a solution of zinc chlorid U.S.P., 64 gm. in water to make 100 gm. The amount of aluminum chlorid and the chlorid of other metals, as found in the second examination, are present in amounts which could not be expected to alter appreciably the expected therapeutic action of a concentrated solution of zinc chlorid, as present in Sensitex or as may be prepared with the required amounts of zinc chlorid in water.

In view of the first and second examinations, the designation "Chloralum-Oxychloride" on the labels is misleading.

DR. STRASSKA'S TOOTH PASTE— NOT ACCEPTABLE FOR A. D. R.

The report which follows was sent to the firm for comment. The firm presented no evidence which would warrant a revision of the statements made below. Consequently, the report was authorized by the Council for publication.

SAMUEL M. GORDON, *Secretary.*

For the past three years, inquiries have come to the A.D.A. Bureau of Chemistry and the Council concerning the composition of Dr. Strasska's Tooth Paste. One of the correspondents of the Bureau writes: "Several of my patients have phoned about the product, saying that it cuts the heavy tobacco stains and whitens the teeth but are wondering if it would harm the enamel in any way." A physician previously had written: "I am preparing a scientific report in which there is a discussion of the formula of the tooth paste used by the Johann Strasska Laboratories, Los Angeles, Calif. I have written to this firm several months ago asking for the formula and have received no reply to date."

It appears that it is the practice of the Strasska Laboratories to keep secret the composition of the product they urge people to use in their mouths by means of newspaper advertising and radio advertising, for when inquiry from the A.D.A. Bureau of Chemistry was directed to the Strasska Laboratories, the information was received that "we do not furnish either a qualitative or quantitative formula

for Strasska's Tooth Paste or its Flavors for the reasons that modus operandi and certain ingredients as well as the *base* and the excipient used are closely guarded." Other statements more in the nature of uninforming sales talk than of scientific statements were included. The following hints as to composition were furnished:

We might add this much to the information you have requested, that Strasska's Tooth Paste is essentially a *SOAP-CHALK* dentifrice, with the soap properly disguised with proper corrigents, which have made people like this dentifrice *which tastes so good.* . . . No chemicals that cause any reaction whatsoever are used in Strasska's Tooth Paste, and we incorporate no pumice, cuttlebone, or similar grit.

In view of these and other noninforming statements, the firm was advised that the product would be listed in the files of the A.D.A. Bureau of Chemistry as a product of secret composition.

In due time, it was felt desirable to examine the product as far as possible so that inquiries from the profession might be answered with as much quantitative information as possible. The chemist's examination, which follows, reveals one of the reasons that the Strasska Laboratories do not care to furnish a quantitative statement of the composition, as the presence of approximately 4 per cent of a silicious material is indicated on examination. It is well known that the use of a material with a hardness approximating silica daily on the teeth cannot be considered in the interests of the dental health of the public. On this account, the Council has not been able to admit to A.D.R. dentifrices containing silica or any of its forms, even though the examination in other respects was satisfactory. In view of this information, the statement of the firm that "we incorporate no pumice, cuttlebone or similar grit" is misleading.

Incidentally, it is of interest to note that the weighed contents of the tubes examined was approximately 14 per cent below the declared amount. Accordingly, another sample of Strasska's Tooth Paste was purchased, and it was found that the deviation from the declared net contents was approximately 17 per cent below the amount stated to be present.

In order to determine whether silica was present in Dr. Strasska's Tooth Paste of other flavors than the "Regular," a sample of the "Double Strength Peppermint" flavor was examined, and this was found to contain 4.8 per cent acid insoluble ash which had the essential properties of silica. The presence of silica was confirmed by petrographic examination.

The chemist's report follows:

One original package of Dr. Strasska's Tooth Paste (Dr. Johann Strasska Laboratories, Los Angeles, Calif.) was received with a request that it be examined for pumice and other acid insoluble material, chalk, soap and glycerin.

The package consisted of a tube of paste, enclosed in a carton and accompanied by a circular.

The following appeared on the label:

"Dr. Strasska's Tooth Paste. Whitens the teeth. Manufactured in America under license and patent rights by Dr. Johann Strasska Laboratories, Los Angeles, Calif. A certified product. There is one best in everything. Johann Strasska. Av. Net. Contents 3⅛ ozs. or 94 grams."

"Wasche die Zähne mit Dr. Strasska's Paste."

The following appeared on the carton: "Strasska's Original Tooth Paste."

The tube contained approximately 80.5 gm. (2⅘ ounces) of a light brown paste possessing a mintlike odor, and a sweet, soapy, mintlike taste.

Qualitative tests indicated the presence of calcium, sodium, carbonate, fatty acids, acid insoluble material, salicyl compounds, saccharin, gums, glycerin and water. Microscopic examination indicated that the acid insoluble material was silica. Starch and starch-containing materials (e.g., orris root), iodin-liberating compounds, heavy metals, magnesium, potassium, sulphate, borate, phosphate, tartrate, halids and sugars were not found.

Quantitative examination yielded the following:

Loss in weight (100 C.)	17.9 per cent
Ash (600 C.)	38.5 per cent
Acid insoluble ash (silica)	4.2 per cent
Calcium (Ca^{++})	13.6 per cent
Carbonate (CO_3——=)	19.5 per cent
"Fatty acids"	10.2 per cent
Glycerin	30.4 per cent

On the basis of the foregoing, the contents of Strasska's Original Tooth Paste may be calculated as:

Calcium carbonate ($CaCO_3$)	11.2 per cent
Silica	30.4 per cent
"Soap"	34.0 per cent
Glycerin	4.2 per cent

Water, flavoring and undetermined excipients to make 100 per cent.

Deviation from declared net contents, 14.4 per cent below.

(End of report)

In view of the foregoing, the Council declares Dr. Strasska's Tooth Paste inadmissible for A.D.R. because the firm withholds from consumers who are asked to use the product a statement concerning the composition and because it contains silica, a potentially abrasive substance, the daily use of which cannot be considered in the interests of the public or the profession.

The Council desires to point out that, at the present time, there are available tooth pastes of known composition, honestly advertised, which are known not to possess materials with such markedly abrasive properties as have been found for silica. The wider use of these honestly marketed tooth pastes should be encouraged.

BUREAU OF PUBLIC RELATIONS

SHOULD DENTISTS HAVE HOSPITAL INTERNSHIPS?*

By SIGMUND W. A. FRANKEN†, D.D.S., and
GEORGE F. SAUER‡, New York City

WHETHER dentists should have hospital internships is scarcely a subject for debate any longer. In fact, the intelligent graduate of today begins to look about for a dental internship at the end of his Junior year. It is interesting to note that this year's vacancy in the dental internship at the Lenox Hill Hospital in New York City enlisted sixty applicants from twenty-four states. These states ranged as far south as Louisiana and Texas, as far north as Minnesota and as far west as the state of Washington, and included many states on the eastern coast.

Many of the applicants labored under a misapprehension regarding the meaning of the term "internship," and it may not be amiss to clarify the terms "intern" and "extern," which have the same significance in dentistry as in medicine.

Dentists, especially in connection with hospitals, should always strive to be on a plane of equality with members of the medical profession and its specialties, and one of the first requisites is an understanding of the more common medical terms. A medical or dental intern is one who sleeps at the hospital, has his meals there, and is on twenty-four hour service, with, of course, occasional periods off duty. He tends the ward patients, usually without pay. A resident intern is one who, as a rule, has had previous experience and receives substantial payment besides board and lodging. He is expected to treat any patients admitted to the private pavilion of the hospital. An extern is a physician or dentist who usually devotes seven or eight hours a day to the hospital. A volunteer is one who devotes a few hours a week to the outpatient division without financial recompense. After a varying period of faithful service, which is considered a trial, he receives an appointment to the outpatient department under the title of "assistant clinical attending."

We cannot stress these definitions too strongly because of the apparent ignorance of so many who apply for the position. There was one man in particular, holding both an M.D. and a D.D.S. degree, who solicited the internship saying that he was specializing in oral surgery and could spend half-days at the hospital. The absurdity of such

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 15, 1932.

†Attending dentist to Lenox Hill Hospital, New York City.

‡Former superintendent of Lenox Hill Hospital.

a statement is self-evident. As a physician, this applicant should have known better, but he evidently thought that dentistry was not on a par with medicine in hospitals.

To return to our subject: Although dental internship is an established fact in a number of hospitals, it is not yet in universal practice.

We should like to discuss the hospitals in the United States which do offer dental internships, and the various facts concerning them. The first tabulation compiled was a preliminary one, in 1927,[1] a final one being compiled in 1928.[2] Then, on account of the number of inquiries which were received and are still being received from all over the country, we decided to check the list and bring it up to date.

Table 1.—States Not Having Dental Intern Service

Alabama	Nevada*
Arizona	New Hampshire
Arkansas	New Mexico
Colorado	North Carolina
Delaware	North Dakota
Florida	Oklahoma
Georgia	Oregon
Idaho*	South Carolina
Iowa	South Dakota*
Kansas	Utah
Kentucky	Vermont
Louisiana	Washington
Maine	West Virginia
Mississippi*	Wisconsin
Missouri	Wyoming*
Montana	

*No registered medical intern service.

The material on which we drew a list of hospitals registered for medical internships.[3] From this list, those having 100 or more beds were selected, and, in December, 1931, questionnaires were sent to them by George F. Sauer, superintendent of the Lenox Hill Hospital in New York City at that time. It seems a pity that at present hospitals are being plagued with more and more questionnaires of doubtful value; which tends to antagonize them against questionnaires in general. Doubtless, each questioner believes his to be the most important, but I leave it to your judgment whether there should be a dental intern reference list for the hundreds of annually graduating dentists who wish to complete their education.

Table 2.—States Having Dental Intern Service*

California	Minnesota
Connecticut	Nebraska
District of Columbia	New Jersey
Illinois	New York
Indiana	Ohio
Maryland	Pennsylvania
Massachusetts	Rhode Island
Michigan	Tennessee
	Texas

*A dental internship is also available in Canada. (Compare Table 3.)

Questionnaires to the number of 667 were sent out in December, 1931, and to date we have received 410 replies, a percentage of 0.608, which is greater than the percentage received from the earlier, 1927, questionnaire. This is gratifying when we consider that many institutions are in these days necessarily and unfortunately cutting down expenses, even on postage. In checking over the replies, it was noticed that twenty-two hospitals which reported having dental interns in 1928 did not

1. Franken, S. W. A.: General Hospitals Having Dental Internships: Preliminary Report, D. Cosmos, 69:297 (March) 1927.

2. Franken, S. W. A.: Dental Internships in General Hospitals of United States, Canada and Philippines, J.A.D.A., 15:768 (April) 1928.

3. Council on Medical Education and Hospitals of the American Medical Association: Hospitals Approved for Internships, J.A.M.A., 97 (Aug. 29) 1931.

reply to the 1931 questionnaire. Therefore, a second request was sent out to these hospitals, in July, 1932, to which sixteen of them replied. These have been included in the totals given before. It was also noted that four hospitals which reported offering a dental internship in 1928 no longer have one, but no reason for the discontinuance was given.

Of the hospitals which replied, seventy-three have dental interns. The total number of interns is 112. It is gratifying to note that the number of hospitals offering dental internships has increased almost 66.66 per cent: forty-five hospitals had them in 1928 and seventy-three have them in 1932, an increase of approximately 15 per cent a year. This is not a spectacular advance in itself, but is an excellent indication of progress in the field, as only a percentage of the institutions returned the questionnaires for record.

The fact that more and more hospitals are establishing dental internships should, in all justice to the work, be given more publicity. Several editors of dental journals have been solicited for suggestions as to how to bring this information before dentists, physicians and hospitals, but, thus far, with but one exception, none has been forthcoming. The need for publicity requires no stronger argument than the fact that, according to a recent publication's[4] answers received to a questionnaire sent out by it, there are only eleven dental interns in the United States. No doubt this erroneous figure was due to the fact that their questionnaire did not make any specific inquiry regarding dental internships, but it seems a pity that such a statement was permitted to creep into a report from so important a source.

Those who would like further information regarding the duties of a dental intern and the organization of a hospital dental service are referred to previous papers on this subject.[5]

The 410 hospitals that replied, which have a total of 131,922 beds, have among them 112 dental interns, making 1,177+ beds to each dental intern, which is far too large a number of patients to each dentist. This total number of interns does not include eighteen who are commissioned in the United States Army as dental interns connected with seven government institutions which replied to the questionnaire, having a total of 3,205 beds. I believe that the United States Army was, or is, trying to have one dentist for each 500 men. When one considers that these men are usually in excellent physical condition, it can be seen how inadequate is this allotment of 112 dental interns for 131,922 general hospital beds. At the Lenox Hill Hospital, we have one dental intern for about 250 ward beds and find that he has plenty of work to do.

It is a disgrace that even today in the United States, supposedly the most advanced country in dentistry, there are more states that do not have dental interns than those that do, as shown in Table 1.

4. Leuck, Miriam S.: Study of Dental Clinics in United States: 1930, A Publication of the Committee on the Study of Dental Practice of the American Dental Association, No. 3, Chicago: University of Chicago Press, 1932.

5. Franken, S. W. A.: Lenox Hill Hospital Plan for Dental Care of Hospital Patients, J.A.M.A., 83:1866 (Dec. 6) 1924; Dental Care of Hospital In-Patients: Lenox Hill Hospital Plan, D. Cosmos, 67:603 (June) 1925; Dental Service in Hospitals: Its Problems and Their Solutions, J.A.D.A., 16:2302 (Dec.) 1929; Oral Care of Hospital Student Nurses, D. Cosmos, 72:865 (Aug.) 1930.

TABLE 3.—DATA ON INTERNSHIPS*

Name	Location	No. of Beds	No. of Dental Interns	Date of Application or Examination	Date of Beginning of Service	Length of Service	Salary or Bonus	Name of Superintendent	Outpatient Dental Department	Dental Intern Work in Outpatient Dental Dep't
California										
General Hospital of Fresno County	Fresno	400	1		July 1	1 year	$25 a month	H. M. Ginsburg, M.D.	Yes	Yes
Los Angeles County General Hospital	Los Angeles	1,716	1	Any time†	Sept. 1	1 year	$20 a month	Norman Martin	No	
Highland Hospital	Oakland	1,179	1		July 1	1 year	$25 a month	B. W. Black, M.D.		
Connecticut										
St. Mary's Hospital	Waterbury	220	1			9 mos. to 1 year	$25 a month	Sister of St. Joseph	Yes	Yes
District of Columbia				Latter part of						
Freedman's Hospital	Washington	316	2	May	July 1	1 year	$10 a month	W. A. Warfield	No	
Providence Hospital	Washington	275	1	Early in year	July 1	1 year	$10 a month	Sister Mary Clare, R.N.	Yes	Yes
Illinois				Jan. 1 to						
University of Chicago Clinics	Chicago	550	1	April 1	July 1	1 year	None	Franklin C. McLean	Yes	Yes
Indiana										
Indiana University School of Medicine and Hospitals	Indianapolis	480	1	June	Aug. 1	1 year	$150 a year	E. T. Thompson, M.D.	Yes	Yes
Maryland				Any	July 1					Emergency
Baltimore City Hospital	Baltimore	2,076	2	time	& Sep. 1	1 year	$25 a month	R. E. Longan	Yes	Only
Maryland General Hospital	Baltimore	228	1	Any time	July 1.	1 year	$10 a month	M. W. Gatch	Yes	Yes
Massachusetts										
Peter Bent Brigham Hosp.	Boston	247	1	July 1.	Aug. 1	1 year	None	Joseph B. Howland, M.D.	Yes‡	Yes
City Hospital	Worcester	400	1	Any time	July 1.	1 year	None	George A. McIver, M.D.	Yes	Yes
Michigan										
University of Michigan Hospital	Ann Arbor	1,100	2	May 1.	July 1.	2 years#	None 1st year $50 a month 2nd year	Harley Haynes, M.D.	Yes	Yes

TABLE 3 (Continued)

Grace Hospital	Detroit	403	2	Nov. 1 to Apr. 1	July 1.	1 year	$25 a month	W. L. Babcock, M.D.	Yes	Yes
Harper Hospital	Detroit	680	2		July 1.	1 year	$50 a month	Stewart Hamilton, M.D.	Yes	Yes
Minnesota										
Minneapolis General Hosp.	Minneapolis	592	3	After Jan 1	July 1.	1 year	None	Charles E. Remy, M.D.	Yes	Yes
University Hospitals	Minneapolis	380	1	Before July 1	July 1.	1 year	None	Paul Fesler	Yes	Yes
Ancker Hospital	St. Paul	1,000	1	Jan.	July 1.	1 year	None	F. G. Carter, M.D.	Yes	
Nebraska										
Creighton Memorial St. Joseph's Hospital	Omaha	400	1		July 1.	1 year	None	Ven. Sister M. Cosma, R.N.	Yes	Yes
New Jersey										
Englewood Hospital Ass'n.	Englewood	212	1		July 1.	1 year	$25 a month	Mary Elizabeth Lewis	Yes	Yes
Medical Center of Jersey City	Jersey City	600	2	June & Jan.	July 1. & Feb. 1	1 year	None	George O'Hanlon, M.D.	Yes	Yes
Mountainside Hospital	Montclair	250	1	June & Dec.	Jan. 1 & July 1.	6 months	$50 a month	Charles H. Young, M.D.	Yes	Yes
Beth Israel Hospital	Newark	450	1	July 1.	July 1.	1 year	None	Paul Keller, M.D.	Yes	Yes
Mercer Hospital	Trenton	250	1	Any time	July 1.	1 year	$30 a month	Fred W. Heffinger	Yes	Yes
New York										
Beth Moses Hospital	Brooklyn	226	1			1 year	None	M. L. Dreyfus, M.D.	Yes	Yes
Cumberland Hospital	Brooklyn	321	2	July 1.	July 1.	1 year	None	Peter J. Johnson, M.D.¶	Yes	Yes
Greenpoint Hospital	Brooklyn	300	2		July 1.	1 year	None	Leon Isgur, M.D.¶	Yes	Yes
*Jewish Hospital	Brooklyn	657	1	Before Nov. 16	July 1.	1 year	None	Samuel G. Ascher	Yes	Yes
Kings County Hospital	Brooklyn	1,660	3			1 year	None	See Note 4		
*Bellevue Hospital	New York City	2,100	6		Jan. 1. Apr. 1. & July 1.	1 year	None	Wm. F. Jacobs, M. D.¶	Yes	Yes
Welfare Island City Hospital	New York City	1,060	1			1 year	None	Mortimer Jones, M.D.¶	Yes	Yes

TABLE 3 (Continued)

Name	Location	No. of Beds	No. of Dental Interns	Date of Application or Examination	Date of Beginning of Service	Length of Service	Salary or Bonus	Name of Superintendent	Outpatient Dental Department	Dental Intern Work in Outpatient Dental Dep't
New York (Con't.)										
Fifth Avenue Hospital	New York City	300	1	Before Jan 1.	July 1.	1 year.	None	W. E. Woodbury, M.D.	Yes	Yes
Fordham Hospital	New York City	406	2		July 1.	1 year.	None	Henry Greenberg, M.D.	Yes	Yes
Gouverneur Hospital	New York City	200	2		July 1.	1 year.	None	R. D. Woods, M.D.¶	Yes	Yes
Harlem Hospital	New York City	325	3		July 1.	1 year.	None	Lawrence Dermody¶	Yes	Yes
Hospital for Joint Diseases	New York City	355	1	Any time	July 1.	1 year.	$25 a month	J. J. Golub, M.D.	Yes	Yes
*Lenox Hill Hospital	New York City	331	1	March.	Sept. 1	1 year.	None	John H. Hayes	Yes	Yes
Lincoln Hospital	New York City	290	2		Oct. 1.	1 year.	None	Rudolph Rapp, M.D.¶	Yes	Yes
Metropolitan Hospital	Welfare Island New York City	1,620	1				Not stated			
Montefiore Hospital	New York City	913	2		July 1.	1 year.	$50 a month	E. M. Bluestone, M.D.¶	No.	
Morrisania Hospital	New York City	550	2	Nov.	July 1.	1 year.	None	Joseph Lanahan, M. D.	Yes	Yes
Mt. Sinai Hospital	New York City	700	2	Any time	July 1.	1 year.	None	Joseph Turner, M.D.	Yes	
N. Y. Polyclinic Medical School and Hospital	New York City	337	3	Any time	July 1.	1 year.	None	A. A. Jaller	Yes	Yes
N.Y. Post Graduate Medical School and Hospital	New York City	415	2	Early in year	July 1.	1 year.	None	T. Dwight Sloan, M.D.	Yes	Yes
Presbyterian Hospital and Sloan Hospital for Women	New York City	728	2	July 1 and Oct. 1.		1 year.	None	John F. Busch	Yes	Yes
Strong Memorial Hospital of University of Rochester & Rochester Municipal Hospital (adjacent & associated)	Rochester	500	1	Prior to Feb. 15.	July 1.	1 year.	None	N. W. Faxon, M.D. SMH, J. W. Thompson, M.D. RMH	Yes	Yes
Grasslands Hospital	Valhalla	680	3	Prior to Mar. 15	July 1.	1 year.	$35 a month for 11 months $215 on 12th month	C. W. Munzer, M.D.	Yes	Yes

TABLE 3 (Continued)

Ohio										
Cincinnati General Hospital	Cincinnati	925	4	Dec.	July 1.	1 year	None	A. C. Bachmeyer, M.D.	Yes	Yes
City Hospital	Cleveland	1,200	1	Prior to Jan. 1.	July 1.	1 year	$600 a year	P. J. McMillen	Yes	Yes
Mt. Sinai Hospital	Cleveland	270	1	Dec.	July 1.	1 year	$10 a month§.	H. L. Rockwood, M.D.	Yes	Yes
St. Luke's Hospital	Cleveland	400	1		July 1.	1 year	None	C. S. Woods, M.D.	Yes	Yes
St. Elizabeth Hospital	Dayton	400	1	Jan. 1.	July 1.	1 year	$25 a month	Sister Superior	Yes	Yes
Miami Valley Hospital	Dayton	396	1	Dec.	July 1.	1 year	$25 a month	E. R. Crew, M.D.	Yes	Yes
Youngstown Hospital Asso.	Youngstown	250	1		July 1.	1 year	$50 a month	B. W. Stewart	Yes	Yes
Pennsylvania										
St. Luke's Hospital	Bethlehem	205	1	Any time	July 1.	1 year	$15 a month	W. W. Butts	Yes	Yes
Bryn Mawr Hospital	Bryn Mawr	261	1	Jan. 1.	July 1.	1 year	$50 a month	C. Willing Hare	Yes	Yes
Chester Hospital	Chester	250	1		Sept.	Indef.	$20 a month	Joseph A. Hulme	Yes	Yes
Hahnemann Hospital	Philadelphia	592	1		July 1.	1 year	None	John M. Smith	Yes	Yes
Hospital of Protestant Episcopal Church	Philadelphia	450	1			1 year	Not stated	Charles A. Gill		
Hospital of University of Pennsylvania	Philadelphia	588	1	July 1.	July 1.	1 year	None	Mary V. Stephenson, R.N.	Yes	Yes
Jefferson Hospital	Philadelphia	688	1		July 1.	1 year	None	H. K. Mohler, M.D.	Yes	Yes
Misericordia Hospital	Philadelphia	250	1	June	July 1.	1 year	None	Mother M. Edmonda	Yes	Yes
Pennsylvania Hospital for Sick and Injured	Philadelphia	280	1	Autumn	July 1.	1 year	None	John N. Hatfield	Yes	Yes
Philadelphia General Hosp.	Philadelphia	2,200	2	Sept.	Oct. 1.	1 year	None	W. G. Turnbull, M.D	No	
Presbyterian Hospital	Philadelphia	374	2		July 1.	1 year	None	Charles S. Pitcher	Yes	Yes
Temple University Hosp.	Philadelphia	355	1	June	June	1 year	None	W. N. Parkinson, M.D.	Yes	Yes
Presbyterian Hospital	Pittsburgh	186	2		July 1.	1 year	None	Mary B. Miller, R.N.	Yes	Yes
St. Francis Hospital	Pittsburgh	500	1	Jan.	July 1.	1 or 2 years	$75 a month	Sister M. Thomasine	Yes	Yes
South Side Hospital	Pittsburgh	225	1	After Jan. 1.	July 1.	1 year	Not stated	Jeanette R. Jones, R.N.	Yes	Yes
Rhode Island										
Rhode Island Hospital	Providence	600	1		July 1.	1 year	None	J. M. Peters, M.D.	Yes	Yes
Tennessee										
Knoxville General Hospital	Knoxville	261	1	Jan & Feb.	July 1.	1 year	$50 a month	Eugene B. Elder, M.D.	Yes	Yes

TABLE 3 (Continued)

Name	Location	No. of Beds	No. of Dental Interns	Date of Application or Examination	Date of Beginning of	Service Length of Service	Salary or Bonus	Name of Superintendent	Outpatient Dental Department	Dental Intern Work in Outpatient Dental Dep't
Texas										
Jefferson David Hospital	Houston	166	3				Not stated	Joe F. Miller	Yes	Yes
Canada										
Montreal General Hospital	Montreal	500**	1	May 27	July 1.	1 year.	None	Arthur L. Walsh, D.D.S. (Dental sup't)	Yes	Visits only

*Except in those hospitals marked with an asterisk, in which the position of intern is obtained by examination, internships are by appointment.
†Appointed under Civil Service rules from eligible list established by competitive examination.
‡Outpatient dental clinic used only as reference clinic by other departments—not open to general public.
#Two year dental intern service leading to degree of master of science in oral surgery.
¶Address all applications to Dr. Harry Selden, Director of Dentistry, 57 West 57th St., New York City.
§Also $15 a month bonus. **Has eight dental beds.

We dentists need not feel unduly depressed, since the six states marked with a star do not have registered medical intern service either. Of course, satisfactory as it would be to reduce the number of states lacking dental intern service below those lacking medical intern service, this is impossible because dentists should not be expected to intern in hospitals which are not registered for medical internships. Our endeavor, therefore, should be to follow the medical profession in providing increased facilities for internships.

The states which do have dental interns are shown in Table 2.

Table 3, which is self-explanatory, gives complete information as to hospitals offering dental internships, location, number of beds, date of appointments, emoluments, etc.

Physicians have a definite set of minimum requirements for a hospital training medical interns. Dentists should also have a standard minimum of requirements for a dental internship. This should not consist merely of expensive equipment and a recent graduate given license to work without supervision among the ward patients. It requires a great deal more. As mentioned before, details have been given in previous papers, but perhaps the most important requirement is that a competent, experienced director be in charge. By "experienced," we mean one having had years of clinic and hospital experience. A dentist might be in private practice twenty-five years and be considered an excellent operator, yet be entirely incompetent to organize and direct a dental clinic or dental division of a hospital. This has been admirably stated by Dr. Burch in quoting from the Committee on Medical Education and Hospitals of the American Medical Association:

Many large, adequately equipped, well-managed hospitals with excellent staffs offer very poor internships because the staff members cannot or will not give the interns sufficient clinical teaching.

Naturally, this applies to dentistry as well as to medicine. An adequate equipment is a requisite; a complete equipment is even more desirable, but most essential is proper and constant supervision with continuous individual teaching.[6]

To judge by some of the replies to the questionnaires, there are many hospitals throughout the country that are willing and ready to establish dental intern service. This, as previously written, can be accomplished at the small cost of $600.00.[7] The money is often available, but the directors are not. Quite a few institutions have gone through the trouble and expense of inaugurating a dental department, only to find, after a trial, that it did not function. Invariably, the main cause for failure was the inability or laziness of the director. On closer scrutiny, it is often found that the director is the most active handshaker in town, or possibly a political friend of a hospital trustee, or he has any one of a number of other qualifications, but is deficient in the one absolute requirement: previous hospital experience.

To close this report of available dental internships, we might say that the situation is improving. More graduates yearly are seeking dental internships. The question may arise as to what benefit it is to the individual practicing dentist. In the first place, it automatically establishes dentistry in the opinion of the young physicians as well as of the older physicians connected with the hospital. They see the work being done, and judge and appreciate its value. Another, and perhaps more selfish reason, is that every ward patient who is benefited by his dental treatment in a hospital is a potential patient for some dentist. This, of course, is likely to increase the interest of the patient's entire family.

CONCLUSION

A good dental internship is a benefit to: (1) ward patients, and therefore to hospitals; (2) the dental intern, in giving him a supervised clinical experience as well as much medical knowledge; (3) the dental profession, by raising its standard, and (4) the members of the dental profession, by creating potential patients.

26 East Thirty-Sixth Street.

6. Footnote 5, third reference.

7. Franken, S. W. A.: Dental Equipment: Its Cost and Installation in a General Hospital, D. Cosmos, 69:186 (Feb.) 1927.

REPORT OF THE COLLEGE COMMITTEE OF THE AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN*

THE work of the College Committee for 1932 has been confined to a questionnaire study of children's dentistry in the dental schools of America. A similar study was made by Dean Leroy M. S. Miner, in 1929, for the association, and read before the American Association of Dental Schools at Toronto.

This report attracted a great amount of interest and brought to the attention of the teachers in our dental schools the fact that the American Association for the Promotion of Children's Dentistry was actively interested in projecting the teaching of children's dentistry in the schools of this country.

The members of the Association at Memphis last year suggested that this year the information be brought up to date by a similar questionnaire employed by Dr. Miner so that the findings could be used as a basis for action during 1932, and for recommendations at the Buffalo meeting in September, 1932. Therefore, at the suggestion of our president, Samuel D. Harris, this program was agreed on by your College Committee and accordingly the following questionnaire was sent to the dean of each of the forty-three dental schools in the United States and Canada. There were thirty-eight replies received, which is indeed a generous response.

*Presented at Buffalo, N. Y., Sept. 15, 1932.

QUESTIONNAIRE

1. Have you a chair in children's dentistry?
2. If so, who holds the chair?
3. Have you a special lecture course in pedodontia? If so, give number of lectures, etc.
4. Have you a separate children's dental clinic? If so, what are your clinical requirements?
5. Do you give any clinical instruction whatever in children's dentistry? If so, what coordination has it with teaching of orthodontia?
6. Remarks:

In the compilation of this report, it is arranged to give the status of children's dentistry as reported in 1929 with the present situation for 1932 for purposes of comparison.

In 1929, twenty-nine schools sent in replies to the questionnaire; and this year (1932), thirty-eight replies were received, with the following results:

Question 1. Have you a chair in children's dentistry?

In 1929: Affirmative, six; negative, twenty-three. In 1932: Affirmative, thirteen; negative, twenty-five.

Question 2. If so, who holds the chair?

This question was not of importance in this report, although the replies were complete in naming the instructor and show that a great deal of interest is being taken in children's dentistry.

Question 3. Have you a special lecture course in pedodontia?

In 1929: Affirmative, eighteen; negative, eleven. In 1932: Affirmative, twenty-four; negative, fourteen.

In 1929, the number of schools where special lectures were given under the department of operative dentistry was 6; in the department of preventive dentistry, 3, and in the department of research, 1. In other words, of the eighteen schools in 1929 giving special lectures in children's dentistry, in six schools these lectures were given in the operative department; in three schools, in the department of preventive dentistry, and in one school, in the department of research; while eight schools had a special course under its own auspices.

Of the schools that have no special lectures, three stated that lectures in children's dentistry were given by the operative department. Twenty-one schools in 1929 gave lectures in children's dentistry.

Number of Lectures Given in 1929: Eleven schools replied as follows: four, sixteen lectures; one, eighteen lectures; one, thirty-three lectures; one, six lectures; one, from eight to sixteen lectures; two, several lectures; one, not definite.

In 1932, the number of schools where special lectures are given under the department of operative dentistry is ten; in the department of oral hygiene and preventive dentistry, four, and in the department of orthodontia, two; or, to state the situation another way: Of the twenty-four schools this year (1932) giving special lectures in children's dentistry, in ten schools, these lectures are given in the operative department; in four, they are given in the department of oral hygiene and preventive dentistry, and in two, they are given in the department of orthodontia; while eight schools have a special course under its own auspices.

Of the fourteen schools that have no special lectures, seven reported that lectures in children's dentistry were given by the operative department; one by the orthodontia department; one by the preventive dentistry department, and one by the clinical pedodontia staff. Therefore, thirty-four schools give lectures on children's dentistry out of the thirty-eight that replied to the questionnaire.

Number of Lectures given in 1932: Twenty-four schools replied to this question, as follows: eight schools, sixteen lectures; four schools, eight lectures; one school, thirty-two lectures and sixty-four hours of laboratory work; two schools, twenty-two lectures; one school, sixty-four lectures; one school, thirty-five lectures; one school, thirty-three lectures; one school, thirty-two lectures; one school, twenty-five lectures; one school, twenty-four lectures; one school, eleven lectures; one school, ten lectures; one school, six lectures. Fourteen did not reply to this question.

Question 4. Have you a separate children's clinic?

In 1929: Affirmative, 13; negative, 16. In 1932: Affirmative, 16; negative, 21; no reply, 1.

Clinical Requirements: In 1929, two schools volunteered information as to the number of hours devoted to children's work, as follows: one, 192 hours; one, sixty-six hours.

In 1932, fourteen schools stated their clinical requirements, as follows: One school: For Juniors: prophylactic treatments, 2 points; cement bases, 2; cement fillings, 2; amalgam fillings, 15. For

Seniors: prophylactic treatments, 2 points; deciduous root treatments, 10; cement bases, 2; cement fillings, 2.

One school states that Juniors are required to take twenty-four lecture hours in pedodontia during the year, and ninety-nine hours of pedodontia in the clinic. The Seniors are required to take ninety-nine hours in the pedodontia clinic. One school states that each Junior and Senior student is required to care for at least one child throughout the school year as a minimum credit, but naturally cares for a number in his routine clinical hours in the infirmary during his last two years of training.

One school reports each third and fourth year student is required to spend thirty-six clock hours in the children's clinic.

One school reports that each Senior is required to earn 400 credits in addition to the general requirement for mouth examinations and extractions. The record for a single average Senior of last year (1931) shows that he performed the following operations: six scalings; five treatments; nineteen amalgam fillings; four cement fillings; one inlay; one gold foil filling.

One school requires ninety-two hours in the special children's clinic, and a technic course of eleven hours is given. In this, a special study of deciduous tooth anatomy and cavity preparation is made. A note book is kept and many drawings relative to the subject are made.

One school requires seventy unit hours for Seniors, and fifteen unit hours for Juniors.

Two schools require that Junior students work three mornings each week exclusively for children throughout the school year.

One school requires in operative dentistry seven half days in work on children under 13 years of age.

One school states that every student during his Junior and Senior years must spend a total of four weeks in the children's clinic, two weeks each year.

One school requires, in the Junior year, 250 units; Senior year, 200 units; approximately three completed cases in the Junior year, and two completed cases in the Senior year.

One school states that the Seniors are required to perform fifteen operations and the Juniors, five operations.

One school requires of the Juniors ninety amalgam, twenty silicate and ten cement fillings, and one pulpotomy; and of the Seniors, ? amalgam; forty silicate and fifteen cement fillings; and two pulpotomies, and a prophylactic treatment for every child treated.

Sixteen schools did not give their clinical requirements in children's dentistry, and eight stated that theirs were included in operative dentistry.

Question 5. Do you give any clinical instruction whatever in children's dentistry? If so, what coordination has it with teaching of orthodontia?

In 1929: Affirmative, twenty-eight; negative, one. In 1932: Affirmative, thirty-six; did not state, two.

In replying to the second part of the question, in 1929, sixteen schools stated active cooperation between the department of orthodontia and children's dentistry service. Four schools indicated no coordination, and one stated that they hoped to develop it.

In 1932, replies to the second part of Question 5, the following is noted: Twenty-six schools report varying degrees of coordination between the teaching of children's dentistry and orthodontia; eight schools report no coordination; three did not reply to the question, and

one school hoped to develop a coordination between the two subjects in the near future.

In analyzing these results, we find that while only thirteen schools of the thirty-eight that sent in replies have a chair in children's dentistry, and only sixteen have a special children's clinic, thirty-six give clinical instruction in this subject, twenty-four have special lecture courses and thirty-four give lectures in the subject.

Unquestionably, greater interest is being taken in the subject of children's dentistry on the part of our teaching institutions, and more attention is steadily being devoted toward developing special clinics and special lecture courses and establishing definite clinical requirements on this subject.

The trend seems to indicate a general move in our schools toward developing a "consciousness in children's dentistry" by teaching the subject sufficiently as a distinct unit separate from the departments of orthodontia, operative dentistry, oral hygiene, etc. Also, there seems to be an indication of earnest endeavor to coordinate the teaching of the subjects of children's dentistry and orthodontia, though at present it is evident that greater attention can be devoted to this phase of these subjects.

That many schools are not overlooking the importance of this is seen from the replies to this question:

One school states: "We are establishing a children's clinic, which will be correlated with orthodontia and also with general instruction about the care, value, and the uses of the teeth, also in regard to diet."

Another states: "The instruction in children's dentistry includes observation of those factors which might be responsible for the necessity of orthodontic treatment. In case orthodontic treatment is necessary, the work is completed by the department of orthodontia in cooperation with the department of children's dentistry."

One states: "Restorations are completed in the children's clinic and the patient is then referred to the orthodontia service, so that students may see the same patient in both departments. The children's clinic is associated with the pediatrics department of the university's research hospital."

Another school reports: "Special stress is laid on children's dentistry by those lecturing on operative dentistry, and an effort is made to carry this out in the clinic. If in orthodontia clinic charts show dental defects in children's mouths, they are sent to the operative clinic to have necessary work done before starting orthodontic treatment."

Another reply states: "The director of this department spends two half days in the children's clinic and there are three half time assistants. The orthodontia service is given in the same wing of the building and the two services are closely coordinated."

Another reply states: "Dentistry for children is associated with both operative dentistry and orthodontics as far as pedodontia and child psychology and related subjects are concerned. Restorative work is treated and regarded as a part of the operative dentist's duties and obligations, and students are taught to regard this part of their work as of primary importance in the practice of dentistry."

Another reply states: "We are contemplating establishing a children's clinic intimately connected with the department of orthodontics and the department of pediatrics of the university medical school."

Many other replies were of similar nature.

In making a report on the status of children's dentistry, it seems fitting and proper to recognize and mention three definite endowments made to the cause of children's dentistry in the recent past.

Dr. Howard S. Lowry, of Kansas City, in 1930, under the terms of his will, left $67,000 of his estate for the purpose of dental care for children. This clinic is being operated by the Kansas City-Western Dental College, through an arrangement with the college.

In March, 1931, Col. Joseph Samuels, of Providence, R. I., established "The Joseph Samuels Dental Clinic for Children," as a part of the Rhode Island Hospital at an outlay of over $300,000, and he has recently given another $10,000 to the clinic.

Also, in 1931, Dr. DeLos L. Hill of Atlanta provided in his will for a gift of $50,000 to the Atlanta-Southern Dental College for the "DeLos L. Hill, Jr. Children's Clinic" in memory of his son.

These endowments are interesting to the members of this Association as they show a public interest in the subject.

The benefactions of the Forsyth brothers, Mr. Eastman, Mrs. Montgomery Ward, Senator Couzins, Murry and Leonie Guggenheim and others, in which children's dentistry shares, are well-known to you. All seem to bespeak the importance attached by both the public and the profession to dental care for the thirty or forty million children of our nation.

In the submission of this report, there is no attempt on the part of your committee to make recommendations of a specific nature, as we feel that this matter should come from the association as a result of general discussion.

We do feel gratified by and very much appreciate the full and frank manner in which the deans of the schools have responded and are showing their interest in the subject of children's dentistry.

Respectfully submitted,

H. E. Friesell.

Leroy M. S. Miner,

A. R. McDowell, *Chairman*,

College Committee

THE MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

By GEORGE H. WANDEL*, D.D.S.

OCTOBER 24-27, the American Public Health Association held its annual meeting at Washington, D. C. In spite of the condition of the times, the attendance was excellent. A fine program and interesting health exhibits were presented during the period of the convention.

On the morning of the second day of the meeting, a very interesting round-table was held for the purpose of discussing important phases of dentistry in the field of public health. This round-table was very well attended and the discussion was most interesting and instructive. However, this was not the only time during the meeting that the dental question entered into the discussions of the convention. Dentistry was frequently brought into the picture throughout the meeting, so much so that there could be no doubt left in the minds of those in attendance as to the urgent need for more thorough cooperation on the part of public health officials and the dental profession in working out a solution for the prevention and correction of dental disease throughout the country.

There was one disappointing observation, the same thing being true in past conventions, and that was the small attendance by representatives of the dental profession. In our estimation, there is no meeting of a national character which offers such valuable contacts and opportunities for developing understanding on the question of dentistry in public health as is offered in the annual meetings of this Association. When it is realized that the membership of this organization is made up of all classes of public health officials, such as directors and members of state and local boards of health, school physicians, medical directors of various state institutions, public health nurses, welfare workers, educators and many others, it is not difficult to appreciate dentistry's place in such an association. Certainly, those members of the profession who are interested in the public health phase of dentistry would find much of value in attending these meetings.

The next annual meeting of the American Public Health Association is to be held in Indianapolis, Ind. The exact dates have not yet been brought to our attention, but it is probable that the convention will take place sometime in October, 1933. We understand that dentistry is to be given a prominent part on the program and we sincerely hope that next year's meeting will see a much better representation from the dental profession.

*Supervisor of the Bureau of Public Relations of the American Dental Association, Chicago, Ill.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

A New and Simple Technic for Obtaining a Correct Bite: A simple technic for ensuring a correct bite in the finished dentures is described by Frederick P. Cottrill (*D. Surgeon,* Aug. 13, 1932). Customarily, the patient is asked to return for the impression taking as soon as the gums become "nice and hard." A little later, the patient returns for the bite taking, and here the real difficulty starts. A pair of models on the bench yield very little information. If the front teeth are mounted, for instance, they give no hint of the correct position, neither do they suggest the height of the wax blocks. If the operator makes up the bite himself, he may have some slight idea, but if the work is done by a mechanic, he must trust to chance. The actual taking of the bite is most annoying and unsatisfactory. Among other annoyances, if the weather is warm, the wax may warp. When the operator comes to the final trying in, the bite may seem to be correct, but it is not easy to determine whether the teeth are showing enough or too much, or have been placed too far out or too far in, or whether the slope is correct. The patient gives little assistance as, with the new experience of having a denture in the mouth, the movements become stiff and unnatural. If the base is wax, it is again inadvisable to leave the plates in the mouth for any length of time. If the technically perfect denture does not afford a correct bite, the operator must begin the case all over again. In an effort to avoid this untoward result, the author began an endeavor to find a method which would ensure the teeth going back in the same position as the natural ones, and give the same type of tooth in regard to color and size and the same bite. The method finally adopted can be employed only in normal mouths. There have been no failures and, in nearly all cases, the patient has been able to eat from the first day. The method is described as follows: The molars and bicuspids are extracted and the patient instructed to return when the gums are sufficiently healed to afford a good impression (from one to three months). The upper and lower incisors are then extracted, only the four cuspids remaining. As soon as the gums lose their soreness and harden a little (within a week or two), an impression is taken of the upper and lower jaw. The tooth shades are determined at this time. The models having been cast, it becomes an easy matter to select suitable teeth and fit them in the exact positions as the cuspids afford a definite guide. Wax blocks are fixed over the back ridges in the ordinary way and a bite taken. This will be found simple with the cuspids in occlusion. The plates are then replaced on the models, the plaster cuspids are broken off and the artificial ones are placed in their correct position. Once the bite has been taken, the cuspids may be extracted at any time and the patient dismissed until needed for the permanent impressions. When the permanent models are taken, the bites are waxed down on them, the models placed on the articulator, the back teeth mounted and the dentures finished off. The author concludes: "It is not usually necessary to try in the plates, but if it is considered advisable, it is an easy matter to use the same plates that were used for the bite, although it may be necessary to run in new gums. I have occasionally found on placing the bites on the new models that the teeth appear to be placed in an extraordinary position, one that, in fact, no dentist would dream of mounting them in. In these cases, I have always felt confident that they would look all right in

the mouth, however grotesque they might appear on the models. I have never yet had reason to regret this confidence; in fact, these cases have generally produced the most brilliant results."

Mouth Lesions from Artificial Dentures: In routine examination of the mouths of forty-five consecutive adults wearing full plate dentures, Lain (*Arch. Derm. & Syph.*, January, 1932) noted that 42 per cent had either stomatitis or glossitis. It was found that many of these cases were due to neglected oral hygiene, malocclusion or trauma caused by imperfect adaptation of the plates to the alveolar processes. In several cases, however, after all ordinary etiologic factors had been eliminated, it was concluded that the poisonous constituents of the dental plates were the offending agents. Analysis of the plates in two of these cases revealed porosity with free mercury sulphide and sulphur in one, and aluminum powder with a trace of zinc in the other. Macroscopic and microscopic examination of other offending plates indicated undercuring with porosity. Each of thirty consecutive adults examined, whose mouths contained two or more metals of different potentialities, registered from 1 to 40 degrees of galvanic current on the micro-ammeter. One case of a metallic upper plate with amalgam fillings below registered a dangerously high degree of current. A large percentage of the patients complained of symptoms, such as metallic taste, burning tongue and acute dental nerve sensations, or presented visible mucous lesions adjacent to or between metallic dentures, from which, after a process of elimination, it was concluded that the etiologic factors were galvanic discharges.—Abstr. *J. A. M. A.*

Shade-View for Roentgen-Ray Films: A means of keeping roentgenograms available for examination and study is described as Ballenger, Elder and McDonald (*J. A. M. A.*, Sept. 24, 1932). A section of black window-shade has openings cut in it to hold clear celluloid pockets, in which the films are placed. A wooden lath, like that in the bottom of the standard shade, is placed at the top and bottom of the film view section, two holes being provided for small bolts to attach it to the lower part of the shade. The sections of shade employed by the authors hold three 15 by 17 inch films. If needed, a second or even a third section may be attached to the same shade.

Ultraviolet in the Practice of Stomatology: In a consideration of ultraviolet therapy in the treatment of various oral conditions, i.e., osteomalacia, Vincent's disease and dental caries, and when used postoperatively, A. T. Rasmussen (*Arch. Phys. Ther. X-Ray Rad.*, July, 1932) presents the following summary of his findings: Ultraviolet ray therapy is one of several valuable means of treating diseases of the oral cavity. A thorough knowledge of biologic effects and a keen perception of the pathologic process involved is necessary for intelligent and successful use of this or any potent remedy. Some periodontal diseases are primarily deficiency diseases, while others are complicated by a disturbed mineral metabolism. Benefits from ultraviolet treatment are both direct and indirect. Not all oral lesions call for ultraviolet ray treatment; in many instances treatment calls for a combination of dental prophylactic preparation prior to irradiation, or the association of medical aid in the management of pathologic stomatologic conditions.

Dental Caries in Native Children: Several investigators have been working at the problem of carious teeth in native children, but, so far, few of the results have been published. Recently, Prof. Middleton Shaw of the Dental School Faculty of Medicine of the Witwatersrand University has published his conclusions based on the study of the available data. He states that the chief predisposing cause of caries at present is the bad diet of recent generations; there is no cause operating today which renders teeth more susceptible to bacteria; there is no difference or degenerative change in the microscopic structure of the teeth at present as compared with those of our ancestors thousands of years ago. These conclusions are in direct opposition to the views of the Mellanbys, who hold that carious teeth constitute an avitaminosis. The data collected from extensive investigations of native school children in this country show, however, that avitaminosis has little or no direct influence on the primary dentition, whatever it may have on the secondary set. Aboriginal native children, in general, have atrociously bad temporary teeth, while their permanent teeth,

especially among the boys, are much better than those of European lads of the same age.—South African Letter, *J. A. M. A.*, July 30, 1932.

Therapeutic Effects of Physical Exercise: Illustrative cases in a series of tests as to the therapeutic effects of physical exercise are reported by Robert L. Johnston (*Arch. Phys. Ther. X-Ray Rad.*, January, 1932). Test exercises were used for diagnosis. The subjects omitted breakfast, rested in bed for thirty minutes, after which the average blood pressure, pulse rate and a basal metabolism test were taken. The subject then stood for two minutes and the pulse rate and blood pressures were taken until the reading was constant. Still standing, the patient then executed stationary running, sixty hops in thirty seconds, after which the metabolism apparatus was immediately attached, with the subject in the recumbent position. Normally, the immediate readings of pulse rate, blood pressure, and oxygen consumption were relatively high and underwent a rapid decrease. Therapeutic exercise, when indicated, consisted of one or both of two types: corrective exercises for faulty posture and daily classes in calisthenics using the "setting up" type of exercise for a period of fifteen minutes. It was shown that physical exercise can be used to impose a load on the human machine and the cardiovascular responses thereto may be evaluated as an index of physical efficiency. Sedentary workers who take insufficient physical exercise acquire atony of musculature and of the cardiovascular system. A period of calisthenics daily produces no significant change in the cardiovascular findings in one month, but the effect of such daily provocation of increase in the metabolic rate is decidedly beneficial in that most persons who are underweight gain weight, appetite is augmented, tendency to fatigue during the day's work is lessened, tolerance to exercise is increased, the amount of sleep required is diminished, and there is an increased fitness for evening pursuits. It is concluded that the earlier benefits from systematic daily exercise are manifested by a better utilization of the oxygen supply during activity, and that more prolonged training results in a much greater supply of oxygen to the tissues.

Preoperative Medication: It is commonly conceded that the purpose of preoperative medication is to prevent psychic shock, and to regulate metabolism. These two objects accomplished, we have as a direct result elimination of any stage of excitement, and the possibility of maintaining a lighter degree of anesthesia or of using a less toxic anesthetic than would otherwise be required. The final result is a better postoperative condition of the patient, greatly decreased postoperative discomfort and delayed postoperative pain. We frequently hear or read the remark that the perfect anesthetic has not yet been found. All of us admit the truth of this statement, but it is probably equally true that no single anesthetic agent will ever be found which can fulfill all of the requirements of a perfect anesthesia. It seems that we must rather look for the perfection, at which we aim, to properly selected adjuncts to the anesthetic agents which we already have. It does not seem reasonable to expect a balanced anesthesia by administering a single anesthetic agent any more than to expect a balanced diet by the use of one kind of food. The single agent may produce anesthesia, the single article of diet may satisfy hunger and both have the virtue of simplicity, but both fall short of meeting the reasonable requirements of the case. In anesthesia, more perhaps than in most other medical matters, it is necessary to consider the patient as a whole. It is impossible, without inviting disaster, to ignore the mental and emotional sides of his being. Someone has said that the frightened patient is already half-shocked, and that statement is certainly more than half true. Many of our foremost surgeons believe in premedication for especially nervous patients. Current medical literature is full of references to this subject, coming from all classes, from eminent members of the medical profession down to those who are engaged in propaganda for some one of the so-called basal anesthetics. The fact of the matter is that all conscious patients, except infants, who come to operation without adequate preliminary medication are more or less apprehensive and many of them are actually frightened. It is also a fact that those who suffer most are usually not the ones who give the greatest outward evidence of fear and nervousness. This is shown in the course of the an-

esthesia. The patients who have a definite stage of excitement are nearly always the ones who suppress every evidence of fear until their volition is abolished. This does not apply to alcoholics, who without proper medication almost invariably pass through a stage of excitement. The result of preoperative nervous strain not only frequently causes a stage of excitement with its attendant dangers, but persists throughout the anesthesia, as evidenced by the character of pulse and respiration, and by the fact that a much deeper anesthesia is required. Such patients are likely to have a stormy recovery with nausea and vomiting, partly due to nervous causes and partly to the deeper anesthesia. The far-reaching effect of preoperative nervous strain may be seen in some instances of delayed convalescence or incomplete convalescence. Probably all of us have seen patients who become invalids after operations which were entirely satisfactory from a surgical standpoint. Cannon has shown that actual physical changes may be caused by psychic shock, fear and anxiety. Dr. Mehrtens has stated that, from a neuropsychiatric angle, he feels sure that fright, anxiety, and other emotional troubles previous to an operation tend to waste the energy of the organism in such a way that it is not available for the necessary expenditures incident to the operation and convalescence, and that this fact cuts down the margin of safety which partly determines the success or failure of an operation. When dealing with the class of individuals whose margin of safety is minimum, it is of the greatest importance to reduce the wastage of energy. Preoperative medication has its greatest sphere of usefulness in this type. Anesthetic deaths occur most frequently in minor operations on unprepared patients, and the lack of premedication may well be a factor.—Caroline B. Palmer, in *California and West. Med.*, May, 1932.

Hypoplasia of Mandible: Obviously, the treatment for this condition is directed toward those measures that will prevent the tongue from being displaced posteriorly. In cases in which the hypoplasia is not marked, postural measures alone are sufficient, for by placing the infant on its face and elevating the body the tongue will remain in its normal position by virtue of its own weight. In the more severe cases, in which posture alone is not sufficient, the brace, as illustrated in the accompanying illustrations, will be as satisfactory as it is simple. This consists of a strong piece of copper wire which rests on a soft flannel band as it passes across the forehead and which is shoed with rubber tubing as it passes down the side of the face to the angle of the jaw. Here it passes under the ramus, forming a right angle to the descending limb. The two ends of the frame are then joined by a piece of white tape which holds the frame firmly in position and tends to maintain the pressure that is exerted against the mandible and the floor of the mouth. The mandible is then displaced forward, and at the same time pressure is exerted against the floor of the mouth and the base of the tongue. Surgical procedures, such as suturing the tip of the tongue to the lip and tracheotomy, may be used, but in our experience such measures were not necessary. Efficient nursing plays an important rôle, as these patients are difficult to feed not only on account of the short mandible but also on account of the cleft palate.—Eley and Farber, in *Am. J. Dis. Child.*

Fresh Cocoanuts as a Dental Cleanser: During a short stay in Leuvuka Island, I was struck by the cleanly appearance of the native children's teeth. Investigating further, first from curiosity and then from a dental interest, I discovered through the courtesy of Father ——— of the Roman Catholic Mission (French Order), that these little dark-skinned children of Nature chew fresh cocoanut pith after eating, or, in fact, almost at any time. The action of masticating this coarse pith almost to a powder gives the tiny jaws the necessary muscular exercise for development and acts as a mechanical cleansing agent for the teeth, removing any glutinous matter like banana, bread, et cetera, which has a tendency to cling to the necks and surfaces of teeth and ferment, the sweetish, oily flavour of the nut increasing the action of the salivary glands, the oil acting as an intestinal lubricant. Amongst many adult natives, especially those employed as house women to the white residents, living on similar food to the white community, and having abandoned their childish habits of chewing cocoanuts, the teeth were more or less affected by caries, whilst in the case of those of unclean or careless habits, the teeth were quite destroyed. Quite taken with the idea of using cocoanut, I have tried the prac-

tice myself for about twelve months, using a piece about two inches square after each meal. They are now using small pieces of fresh cocoanut, to be well masticated after eating the biscuit—pap clinging to the teeth; teeth, gums and tongue look quite clean. This is not recommended in place of the daily use of a toothbrush, but only as an assistant cleanser, developer and stimulus.—V. B. Kennard, The Crescent, Homebush, N. S. W.

The Explosion Hazard in Anesthesia: Ethylene should under no circumstances be used in any operation in which an actual cautery or surgical diathermy apparatus is to be used, and ether should never be used in any throat operation in which a cautery or surgical diathermy or similar apparatus is required. Care should be taken, especially in very dry weather, not to comb or stroke the patient's hair until the ethylene has had time to become thoroughly dissipated. It would be well if the hair was wrapped in a linen binder during and immediately after the operation. It has been suggested that the passage of the dry gases through the tubing may be a source of internal electrification of the apparatus. This is not the case if the gases are perfectly clean and free from dust particles or from droplets of vapor. However, if the inside of a rubber tube is dusty, or if any metallic powder from wear of valves, etc., is carried along the inside of the tubes by the current of gas, charges of several thousand volts may build up in a few seconds. I have verified this experimentally. It is a mistake to think that moisture from the patient's body will keep the interior of the rebreathing bag and the rubber tubing moist. Even a wet sponge placed therein dries out rapidly, since the gases that are compressed in cylinders require to be made very dry in order to prevent freezing of the expansion valves. These dry gases absorb water with great avidity. Also, they will not be saturated by passage through water unless the water is kept warm or precautions are taken to assure breaking up of the gas into small bubbles. Finally, I would state that it is my considered opinion after a careful investigation that there is a real and serious hazard in the use of ethylene or ether in modern anesthesia apparatus in which the combustible gas or vapor is mixed with oxygen or nitrous oxide and contained in or passed through rubber rebreathing bags and rubber tubing. This hazard is greatly increased by the practice of washing out the apparatus and the patient at the end of the procedure with oxygen-rich mixtures.—Horatio B. Williams in *J. A. M. A.*

MISCELLANY

SOCIAL INSURANCE (Conclusion)

By EDWARD H. OCHSNER, M.D., Chicago, Ill.

The purpose of this series of articles on social insurance has been to arouse the rank and file of the medical and dental professions, and through them, if possible, the general public, to an impending danger; and to dispel a number of quite generally held false opinions.

The first of these is the very common belief that the moment a professional man assumes a title and a government position, he knows more and becomes more efficient than he ever was before, while the contrary is more often the case because of the enervating effect of red tape and paper work.

The second common error is that, by some magic, compulsory health insurance is going to escape the favoritism, nepotism, graft and, in fact, all the evils of politics. This is a delusion, with which reformers and the intelligentsia in general are commonly afflicted. The practical man of affairs and particularly the seasoned politician does not fall into this error. Some time ago, during a heart-to-heart conference, a practical politician expressed what he really felt and knew to be true. He said, in substance, that we must remember that "we have government by politics, and you and I or all of us with a hundred thousand others cannot change this situation." And he added: "I do not care whether you remove the control from the city to the state or to the federal government, it will still be controlled by politics."

The third common error, again held particularly by the reformers and intelligentsia, is that statisicians and economists can solve this problem unaided. Desirable, valuable and even necessary as a study by competent economists is to a complete understanding of the problem, there is one very important fact which many who have made a study of the problem do not seem to be able to realize; namely, that where personal relation is such an important element as in the practice of medicine and dentistry, the ordinary formulas employed by economists do not and cannot apply. The personal relation cannot be measured by any mathematical formula devised. It is too elusive to be measured by monetary or any other standards and yet of all factors in the makeup of medical practice, it is by all odds the most important. Only the person who has had an extensive experience in the practice of medicine or dentistry or the one who has had a long and serious illness seems to be able to evaluate properly this phase of the problem. Again, a lack of medical knowledge makes it impossible for economists to appraise the difference between the personal individual care of the patient by the private physician and the more or less impersonal mechanical care of the panel or *Krankenkasse* physician; nor are they so situated as to have access to individual patients and, even if they had, they lack the training to know which is giving the better treatment. From the foregoing, it must be evident that this type of study and investigation has its limitations when the personal element enters intimately into a social or economic problem, and if too much dependence is put upon it, wrong conclusions are bound to be reached; or, to state this point a little more concisely, let us say that statistics have their value and their limitations. The more personal the matters under investigation, the less their value and the greater their limitations. One writer has expressed this idea very well in the following words: "There is real danger that the economist lost in the abundance of his researches finally overlooks the plain and easy road that lies directly before him."

Probably the most common error is the belief that social insurance will abolish poverty. To the contrary, it is at best only a palliative and, like all palliatives, if employed for any considerable period of time, always leaves conditions worse than when first employed.

Another error quite generally made by the more sensitive and emotional is to believe that the receiving of charity is of all things possible the most degrading. Serious as the accepting of charity is to the character of the intelligent and sensitive, there are many other things even worse, and one of these is the quite general practice of malingering, which compulsory health insurance and the dole encourage and foster among the workers of a nation. There is this fundamental and very important difference between accepting charity and a health insurance stipend: the former is still considered somewhat of a disgrace, while to get the latter, even through subterfuge, is considered hightly respectable and clever.

There are two questions that the compulsory health insurance proponents have never answered, in spite of the fact that they have offered innumerable alibis that do "not alibi" and endless explanations that do not explain: 1. Why, if compulsory health insurance improves the health of a nation, as claimed by its proponents, is the death rate no lower in those countries that enjoy this "great blessing" than in those countries not so blessed? 2. Why, shortly after and since the introduction of compulsory health insurance, have the number of days lost by the workers per annum steadily increased? The answer to the first question is that it does not improve the general health of the people and the answer to the second is that among a very large percentage of the working population, it substitutes for the will to get well and the will to work, the will to stay sick and the will to loaf.

Personally, I am quite satisfied that Germany and England should make their experiments in social insurance and Russia her experiment in state medicine, but I am happy that these experiments are being made three and four thousand miles, respectively, from our shores. I am firmly convinced that if we can stave off these schemes for another ten years, we will be spared them, because they will prove so harmful to medical practice and medical progress and so destructive to national character that we will escape their blight. Time will demonstrate that they are fundamentally wrong, a backward step in civilization.

Human progress in most lines has always been very largely the result of unhampered personal endeavor and rarely if ever the result of governmental action primarily. Will we never be able to learn from experience and must there always be recurrent periods of halting and even of retrogression in human progress?

American medicine and dentistry stand today at the threshold of their greatest opportunities and beside the abyss of their greatest dangers; the former because of their marvelous advances in the recent past; the latter because they are being pestered and annoyed by a small but vociferous group of misinformed, uninformed, unwise and, in a few instances, self-seeking, selfish, self-appointed lay advisers. These are troubled times for the two allied professions. The men who stand firm now will deserve the gratitude of future generations of men and women.

CHICAGO CENTENNIAL DENTAL CONGRESS TO BE MOST ELABORATE MEETING IN HISTORY

A preview of the preliminary plans for the Chicago Centennial Dental Congress indicates clearly that the congress will be the most comprehensive and elaborate dental meeting ever staged. In the first instance, it will combine the Seventy-Fifth Annual Session of the American Dental Association and the sixty-ninth annual meeting of the Chicago Dental Society. Sessions will be held in the Stevens Hotel, Aug. 7-12, 1933. Those who have attended these two meetings in past years can readily appreciate that the combination will produce an unprecedented dental gathering. Add to this the fact that the dates coincide with the peak period of the A Century of Progress Exposition (Chicago World's Fair), and the setting for the meeting becomes ideal.

Beginning June 1, 1933, the opening date of the World's Fair, and continuing until the closing date, Oct. 31, 1933, the Congress, in cooperation with the American Dental Association, will present an elaborate popular dental exhibit in the Hall of Science on the Fair Grounds. It is anticipated that at least 50,000,000 persons will view this exhibit. A future article will deal with this project in detail.

Now to look at the program: Registration

of visitors will begin Saturday and continue throughout Sunday. In the evening, the annual dinner and meeting of the American College of Dentists will be held.

Monday. The exhibitors' demonstrations will be the first order of the day, in the Grand Ball Room. Later, there will be the first showing of the section on scientific exhibits, followed by historical addresses in all sections. The first general meeting will be held in the afternoon, featured by the presidents' addresses. In the evening, the various dental fraternities will hold their annual dinners.

Tuesday. The first morning general meeting will open with a paper on operative dentistry, mouth hygiene and prevention. This session will be held concurrently with lecture demonstrations in all sections. The second afternoon general meeting will feature a paper on full denture prosthesis. In addition, there will be papers read in all the sections. At the evening general meeting, there will be a guest speaker of national reputation whose topic will be nondental and of general interest to all visitors.

Wednesday. The second morning general meeting will be given over to a paper on partial dentures, crowns and bridge work and ceramics. At the same time, there will be general clinics in all sections. In the afternoon, there will be general meetings devoted to oral surgery, anesthesia and radiology, with papers read in all sections. The evening will be devoted to annual banquets of such organizations as the college alumni associations, dental hygienists, dental assistants, etc.

Thursday. A paper on orthodontia will headline the morning general meeting. Concurrently, there will be lecture demonstrations in all sections. The afternoon general meeting will be given over to oral pathology and therapeutics. The various sections will be occupied with the presentation of papers. The evening has been designated as gala night at the Exposition. The nature of the program for this evening has not yet been fully developed, but it is safe to say that the memory of it will linger long in the minds of those present.

Friday. The morning general meeting will be devoted to a consideration of the biologic sciences and research, with a paper on the subject. Concurrently, there will be lecture demonstrations in all sections. The afternoon general meeting will be devoted to a paper on dental health. At the same time, there will be papers in the various sections. The president's ball, the crowning social event of the Congress, will be held in the evening.

Saturday. Special attention will be paid the manufacturers' exhibit in the morning. General clinics will be held in all sections, and also special clinics in the grand ball room. At 12 noon, the Congress comes to an end.

The foregoing is a very sketchy outline of the program. There will be many recreational activities, such as golf, and trapshooting, which remain to be arranged. Future issues of THE JOURNAL will go more into detail about the meeting, the World's Fair and Chicago as a convention city.

In the meantime, it is the desire that every member of the American Dental Association consider that he has been personally invited to attend this history-making congress.

ADMISSION OF DENTISTRY TO THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Committee on Education, Research, and Relations of the American College of Dentists, which was appointed in 1928, included in its work an endeavor to bring about the admission of dentistry to association with the American Association for the Advancement of Science. After preliminary presentations of the reasons that dentistry should thus be recognized, and certain misapprehensions among scientific men had been removed, the American College of Dentists appeared to be the most desirable organization to represent the claim for immediate association. In presenting the claim of the College, it was made clear, that other organizations in dentistry should, as soon as possible, be brought into the same relation. The A.A.A.S. admitted the college into association in 1931; and having received applications from the American Dental Association and the American Association of Dental Schools, has recently admitted these two bodies to the same relationship. These three dental organizations are now related with Section N ("medical" sciences).

The first meeting of dentists in association with the A.A.A.S. will be held in Atlantic City, December 30, under the direct auspices of the first dental organization admitted to association. In the succeeding years, the dental meetings will be conducted by a special

committee of dental members of the A.A.A.S., who will coordinate the efforts of all the associated dental organizations.

CORRESPONDENCE

"Restoration of Teeth During the Childhood Period"

To the Editor:

I have just read the article by Joseph K. Wampler in The Journal for November. It gives me pleasure to see articles on this subject appear in dental journals, because it indicates an interest by dentists in this important subject.

There are several statements in this paper which I thoroughly disagree with. I shall therefore take up some of the points made in the order in which they appear.

1. "The average general practitioner has neglected children's dentistry not because of a lack of interest and appreciation, but because of uncertainty as to the proper steps of procedure and lack of experience."

My opinion is that most of the work done is of too temporary a nature and both the parent and the dentist have become discouraged. Another reason is the belief held by many dentists that adequate remuneration cannot be obtained to make carefully done work for children profitable.

2. "I have placed copper amalgam at the head of the list of filling materials because it is more commonly indicated in the filling of children's teeth."

I have placed copper amalgam nearer the foot of the list of filling materials because it has proved to be almost worthless except for use as a last resort in the teeth of very young and difficult children, where, on rare occasions, it will be found impossible to do anything requiring more time, a dry field of operation and more precise operative technic. Copper amalgam will serve a temporary purpose in such cases. Later, when a better operative field may be maintained, the copper amalgam may be replaced by a more nearly perfect restoration.

3. "It may be placed closer to the pulp than any other filling material without causing injury to the pulp."

This statement is open to question and qualification. It does not take into account the fact that such materials as pulp capping and cavity lining exist. Copper is a good conductor. Amalgam expressed dry as advocated requires pressure to pack.

4. "It needs less preparation for retention than do other materials."

Why? It is not adhesive.

5. "It has greater crushing strength than most silver amalgams."

A really good silver amalgam has ample crushing strength. Why choose a poor one?

6. "It protects the margins of the cavity from recurrence of decay because of the germicidal action of the copper salts."

The edge strength of copper amalgam is very poor, especially where cavity margins have been beveled as illustrated in this article. Copper amalgam will wear and dissolve away. Copper amalgam squeezed dry as advocated before packing is likely to have poor adaptation and therefore leak. (If you doubt this statement, try packing a die or a cavity prepared in a bone toothbrush handle, using this technic and no more pressure than may be exerted in a child's tooth. Separate or knock out the filling and examine for adaptation.) It has not been my experience that the germicidal action of copper is sufficient to prevent decay around such fillings.

7. "The deposition of copper salts also tends to change the bacterial flora of the entire mouth; which inhibits decay in other teeth."

I should like to see some real proof of this statement. It is my opinion that the value of copper in preventing decay is grossly overestimated.

8. "It is impossible to establish an ideal contact point with copper amalgam."

With this I agree. Even if established, it would not remain. Proper occlusal contact cannot be maintained. With neither occlusal nor interproximal contact properly restored and maintained, of what great value is the restoration?

9. "Cements and synthetic porcelain fillings will invariably have to be replaced every few months."

While I do not consider cements or silicates to be really permanent materials, this statement is too strong. I have seen many of them last two years or more.

10. "Copper amalgam is also indicated in the deep fissures and partially erupted first permanent molars when they are not in normal occlusion and are therefore not self-cleansing."

Some operators hold this belief. I treat many of these cases by precipitating ammoniacal silver nitrate into the fissures. The

precipitating agents used are first 10 per cent formalin and then oil of cloves. If the trouble has passed beyond a state of incipient caries gold foil or silver amalgam are used. I believe that fillings made properly will hold up.

11. "Guttapercha is indicated in first permanent molars where, in malformed occlusal surfaces, decay has attacked the deep pits over the entire surface. . . . A patient may be carried through childhood with this type of filling. . . ."

Guttapercha used in this way tends to become foul, pull away from the walls of the cavity and allow leakage. It will not stand attrition. It is entirely too temporary a service, and the necessity of frequent replacement with the attendant expense, discomfort and inconvenience renders it unfit for use.

12. "It is my opinion that silver amalgam has no place in children's dentistry. . . . Even the most carefully placed silver amalgam filling will leak at the margins, with subsequent decay and possible death of the pulp, after a period of six months in the mouth of the average child."

It is almost inconceivable that a man can make such statements and then advocate guttapercha fillings, in a publication like THE JOURNAL.

It is my opinion that a dentist making such statements has something to learn about silver alloys and the technic of their use. If the author will visit me in Toledo, I can show him the mouths of some of my child patients with large complex cavities filled with silver alloy which have been in place for much more than six months and are still in good condition.

If I placed a silver amalgam filling in the mouth of a child or grown up, and it showed faulty margins or leakage at the end of six months or less, I would be so chagrined that I would gladly replace it without cost to the patient, and feel that in addition I owed him an apology.

I have in my own mouth large silver amalgam fillings placed before I was 10 years old. I am now 32. Every one of my bicuspid and molar teeth contain large fillings, most of which are silver amalgam. Not one of these fillings has ever had to be replaced because of leakage or decay around them.

I have never before written a criticism of any article published in a dental journal. I have never written any article for publication. If Dr. Wampler's ideas are shared by any considerable number of dentists, I think my pen has work to do.

This letter is not written in the spirit of animosity or with the desire to hurt any one. It is written because I love children and would like to see them better served.

VARIAN A. SWEETNAM,
561½ East Broadway,
Toledo, Ohio.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association in conjunction with the Chicago Centennial Dental Congress, Chicago, Ill., Aug. 7-12, 1933.

American Association for the Advancement of Science, Atlantic City, N. J., December 30.

American Society of Orthodontists, Oklahoma City, Okla., April 19-21.

Dental Protective Association of the United States, Chicago, Ill., December 19.

Greater New York December Meeting, New York City, December 5-9.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Washington University Dental Alumni Association, St. Louis, Mo., February 20-22.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

December

Ohio, at Cleveland (5-7).

February

Minnesota, at Minneapolis (7-9).

April

Connecticut, at Bridgeport (19-21).
Michigan, at Grand Rapids (10-12).
Tennessee, at Knoxville (27-29).

May

Pennsylvania, at Philadelphia (2-4).

STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, December 12. Board of Dental Examiners, California State Bldg., Los Angeles.

Delaware, at Wilmington, January 18-19. W. S. P. Combs, Secretary, Middletown.

New Jersey, at Trenton, December 5-10. John C. Forsyth, Secretary, 148 N. State St., Trenton.

North Dakota, at Fargo, January 10-13. R. E. Percy, Secretary, Mandan.

Pennsylvania, at Philadelphia and Pittsburgh, December 7-10. W. A. McCready, Secretary, 1115 Highland Bldg., Pittsburgh.

Rhode Island, at Providence, December 6-8. Albert L. Midgley, Secretary, 1108 Union Trust Bldg., Providence.

South Dakota, at Sioux Falls, January 5-7. Jolin J. Berry, Secretary, Deadwood.

Wisconsin, at Milwaukee, December 12-17. S. F. Donovan, Secretary, Tomah.

MINNESOTA STATE DENTAL ASSOCIATION

The Golden Jubilee Meeting of the Minnesota State Dental Association will be held in the Municipal Auditorium, Minneapolis, February 7-9. For details and preliminary program, address

L. M. CRUTTENDEN, *Secretary*
435 Hamm Bldg.
St. Paul

DENTAL INTERNSHIP

Applications for the dental internship at Georgetown University Hospital, Washington, D. C., should be sent to the Chief of the Dental and Oral Surgery Department, Georgetown University Hospital on or before March 1, 1933. The vacancy will occur July 1 and the internship is for one year.

SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the South Dakota State Board of Dental Examiners will be held at the Carpenter Hotel, Sioux Falls January 5-7. Applications, with necessary fee, must be in the hands of the secretary at least ten days prior to date of examination.

JOHN J. BERRY, *Secretary*
Deadwood

PENNSYLVANIA STATE DENTAL SOCIETY

The Pennsylvania State Dental Society will hold its sixty-fifth annual meeting at the

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

Bellevue-Stratford Hotel, Philadelphia, May 2-4.

J. A. SALZMANN, *Chairman,*
Publicity Committee
210 Fairmount Ave.
Philadelphia

CONNECTICUT STATE DENTAL ASSOCIATION

The sixty-ninth annual meeting of the Connecticut State Dental Association will be held at the Stratfield Hotel, Bridgeport, April 19-21.

C. W. VIVIAN, *Secretary*
New Britain

DELAWARE STATE BOARD OF DENTAL EXAMINERS

The Delaware State Board of Dental Examiners will hold its next regular examination for the purpose of licensing dentists and dental hygienists to practice in Delaware, January 18-19, at the Municipal Bldg., Tenth and King Sts., Wilmington. Applications must be on file in the secretary's office ten days before the date of examination. For further information, address

W. S. P. COMBS, *Secretary*
Middleton

NINTH DISTRICT DENTAL SOCIETY

The next meeting of the Ninth District Dental Society will be held December 10, at the Transportation Club, New York City.

J. E. HUGHES, *Secretary*
Tarrytown

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY

The next meeting of the American Society for the Advancement of General Anesthesia in Dentistry will be held on Monday evening, December 12, at the Barbizon-Plaza Hotel, Fifty-Eighth St. & Sixth Ave., New York City, with dinner at 7 o'clock and the scientific session at 8:15. Reservations for the dinner may be made through M. Hillel Feldman, 750 Fifth Ave., New York City.

LEONARD S. MORVAY, *Secretary*
76 Clinton Ave.
Newark, N. J.

WASHINGTON UNIVERSITY DENTAL ALUMNI ASSOCIATION

The Washington University Dental Alumni Association will hold its annual meeting, February 20-22. Postgraduate courses and lectures will be given by members of the faculty. No charge will be made for these courses. The meeting will be held at the school, 4559 Scott Ave., St. Louis, Mo.

LEO M. SHANLEY, *Secretary*
4482 Washington Ave.
St. Louis, Mo.

ALPHA OMEGA FRATERNITY ALPHA ZETA GAMMA FRATERNITY

September 17, an agreement was drawn up by the Alpha Omega and Alpha Zeta Gamma fraternities whereby the former annexed the latter. All persons interested please take notice.

A. M. FLASCHNER, *Supreme Scribe*
419 Boylston St.
Boston, Mass.

ALPHA OMEGA FRATERNITY

The Alpha Omega Fraternity will celebrate its twenty-fifth anniversary convention at the Lord Baltimore Hotel, Baltimore, Md., December 26-28.

A. M. FLASCHNER, *Supreme Scribe*
419 Boylston St.
Boston, Mass.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The first meeting of dentists in association with the American Association for the Advancement of Science will be held in Atlantic City, N. J., December 30.

ORTHODONTIA EDITORIAL REPRODUCED IN FORM SUITABLE FOR FRAMING

In response to numerous requests, the tribute to orthodontia which originally appeared as an editorial in THE JOURNAL has now been reprinted in a form suitable for framing, on parchment-like paper, measuring 9 by 12 inches. The initial letter is colored and may be obtained in green or red as preferred. The cost of each copy is 50 cents. Send your order and remittance to the Library Bureau of the American Dental Association, 212 E. Superior St., Chicago, Ill.

PER CAPITA SUBSCRIPTION OF STATES TO RELIEF FUND

The following is a list of the average amount subscribed to the Relief Fund by each member from every state.

Are you proud of the record made by the members of your state? If you are, then do your best to keep your state among the leaders. If you are not, redouble your efforts and your subscription so you may be among the leaders.

Alabama	$0.29	Nevada	$0.25
Arizona	1.25	New Hampshire	.30
Arkansas	.22	New Jersey	.61
Army	.31	New Mexico	.69
California	.45	New York	.91
Colorado	.55	North Carolina	.37
Connecticut	.56	North Dakota	.55
Delaware	1.37	Navy	.29
Dist. of Columbia	.65	Ohio	.43
Florida	.36	Oklahoma	.26
Foreign	1.34	Oregon	.42
Georgia	.36	Panama Canal Zone	.88
Idaho	.65	Pennsylvania	.62
Illinois	.42	Puerto Rico	.50
Indiana	.43	Rhode Island	.63
Iowa	.48	South Carolina	.38
Hawaii	.55	South Dakota	.32
Kansas	.36	Southern California	.45
Kentucky	.30	Tennessee	.30
Louisiana	.40	Texas	.40
Maine	.43	U.S. Public Health	.22
Maryland	.72	U.S. Veterans Bureau	.19
Massachusetts	.45	Utah	.71
Michigan	.41	Vermont	.33
Minnesota	.50	Virginia	.49
Missouri	.80	Washington	.35
Mississippi	.18	West Virginia	.33
Montana	.48	Wisconsin	.47
Nebraska	.32	Wyoming	.80

Do You Remember?

Last year when you read about little Mickey Fosset, the 5 year old Memphis boy, and how he was going to put away a penny a day for the Relief Fund, you too resolved that you would put away a coin every day.

You surely remember that! And now don't forget to send the money in!

This year the demands on the Fund are heavy. There is much suffering; many have struggled along through these days of poverty until they can go no farther. We must help them *now.*

Let your donation be large enough to include a contribution on behalf of some of the others who are not able to give anything at all.

The need was never so great as now.

The Dental Relief Fund Committee

R. Ottolengui, *Chairman*
Olin Kirkland
Edward G. Link
William T. Chambers
Fred R. Adams, *Secretary*

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1932-1933

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Report of Independent Survey of Dental Journals*

Made by

Hutchins Advertising Co., Inc.

Rochester, N. Y.

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● To determine which are the best Dental Journals in the United States for the advertising of one of our clients, a large manufacturer of dental equipment, we have conducted a survey among 400 Dentists, picked at random throughout the United States.

● Each dentist was asked to indicate his preference by placing the numerals 1, 2 and 3 opposite his 1st, 2nd and 3rd choices on a list of 14 leading Dental Journals. The names of the publications were listed in alphabetical order.

● Of the 221 replies received 207 indicated their 1st, 2nd and 3rd choices as requested. The other 14 merely checked 3 of the publications with a check mark.

● The total number of First Choices received by all the publications which received any First Choices were as follows:

JOURNAL OF THE AMERICAN DENTAL ASSOCIATION	**86**
Publication No. 2	**35**
Publication No. 3	**28**
Publication No. 4	**25**
Publication No. 5	**17**
Publication No. 6	**2**
Publication No. 7	**7**
Publication No. 8	**4**
Publication No. 9	**3**

**Includes data from questionnaires received since publication of analysis under date of June 24, 1932.*

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AMERICAN DENTAL ASSOCIATION
COUNCIL ON DENTAL THERAPEUTICS

TO KEEP THIS SEAL UNTARNISHED

To keep on earning the approval which your Council on Dental Therapeutics has given us, Doctor, is a goal worth working for.

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We are proud of the enormous public acceptance of Colgate's. (After all, with 30 years' testing, the public ought to know.)

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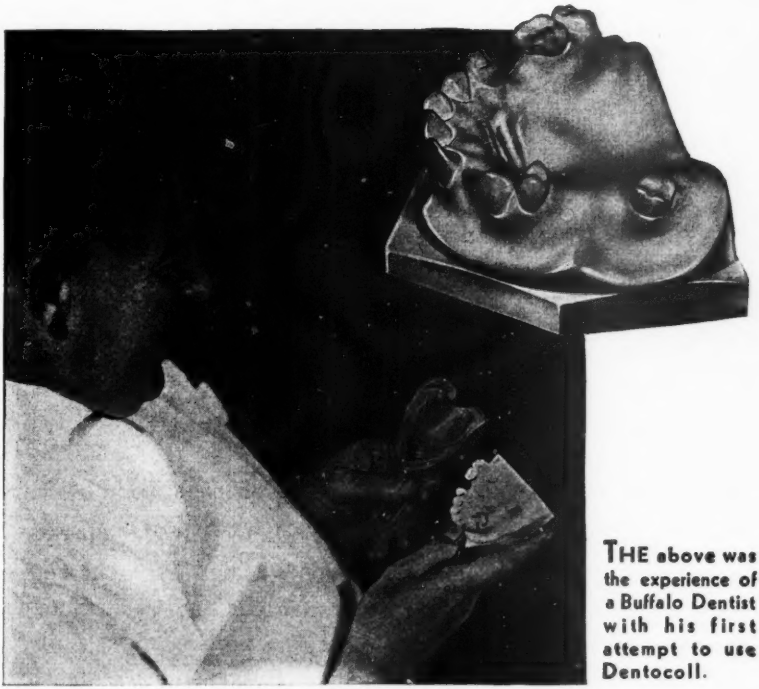

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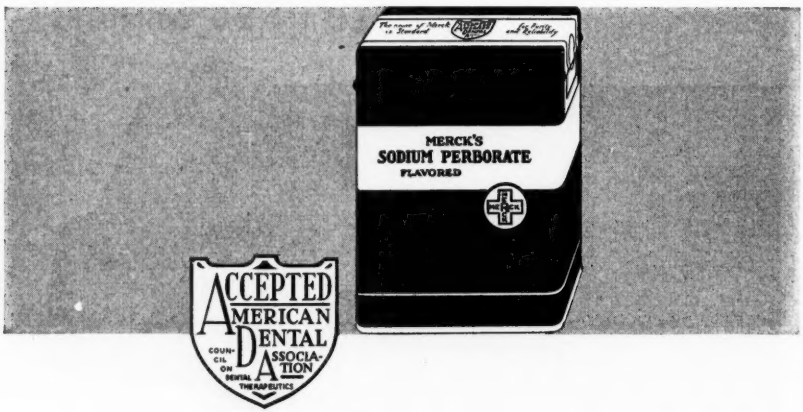

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STILL GOING STRONG

YOUR JOURNAL

continues to lead by a wide margin. Another issue of "Preventive Dentistry," an Australian publication, which states its purpose to be "A Monthly Review of the Dental Literature of the World" shows "The Journal" leading by a wide margin.

●

Publication	*Number of Citations* Issue No. 3	Issue No. 2	Total
The Journal of the American Dental Association	9	10	19
British Dental Journal	6	6	12
The Dental Magazine and Oral Topics	5	3	8
The Australian Journal of Dentistry	3	0	3
The Dental Journal of Australia	3	3	6
The Dental Cosmos	1	3	4
La Revue de Stomatologie	1	1	2
The Dental Record	0	5	5

●

This recognition of The Journal's outstanding contribution to Dentistry, coming from a foreign land, is the most convincing evidence of its real value.

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SQUIBB DENTAL CREAM gives a new meaning to "cleanness." It cleans teeth the way you like to see them cleaned—and aids in eliminating the causative factors of caries without the slightest danger of injury to the teeth or delicate gum edges.

Squibb Dental Cream is made by a scientifically balanced formula which includes a sufficient amount of Squibb Milk of Magnesia, an effective antacid and gentle cleansing agent. It is designed to remove the mucin plaque and prevent the massing of lacto-bacilli and the concentration of bacterial acids.

There is nothing gritty, irritating or soapy about Squibb Dental Cream. This smooth, creamy, pleasant-tasting dentifrice goes as far in the safe cleaning of the teeth as a dentifrice can go.

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For children whose teeth decay easily . . . . this richer cod-liver oil!

To give these children the extra Vitamin D they need, prescribe a richer cod-liver oil.

That's what "10 D" is . . . a cod-liver oil to which Viosterol has been added.

It supplies *ten times* more of the important tooth-and-bone building factor than the cod-liver oil defined as a standard by the Wisconsin Alumni Research Foundation.

Given regularly *every day*, it will help children to build sound, even, well-spaced teeth that will be an asset to them all through life.

Squibb Cod-Liver Oil with Viosterol-10 D also provides an abundance of Vitamin A, the factor which is needed for good general resistance and growth. In winter when children are so subject to ills, they particularly benefit from an addition of this resistance-building factor to their regular diet.

Dentists can depend on the richness of *Squibb*-10 D Oil in both these factors. Squibb's is physiologically tested and *guaranteed*.

Each 100 grams contains not less than 13,333 curative units of Vitamin D and not less than 70,000 units of Vitamin A.

For children every day, always recommend *Squibb's*. The Squibb regular cod-liver oil and Squibb Cod-Liver Oil with Viosterol-10 D come either plain or mint-flavored. At any reliable drug store.

Easy to take! A new concentrate of cod-liver oil vitamins by Squibb!

For older children and adults who object to the taste of regular cod-liver oil, recommend *Squibb Adex Tablets-10 D!* Each tablet contains as much Vitamin A and Vitamin D as *one-half teaspoonful* of Squibb Cod-Liver Oil with Viosterol-10 D. Small, chocolate coated, they are pleasant to take! Remember the name—*Squibb Adex Tablets-10 D.*

Squibb 10 D—A richer cod-liver oil of *known* Vitamin D potency. Guaranteed and tested to contain *ten times* more Vitamin D than the cod-liver oil used as a standard by the Wisconsin Alumni Research Foundation. Always insist on Squibb's!

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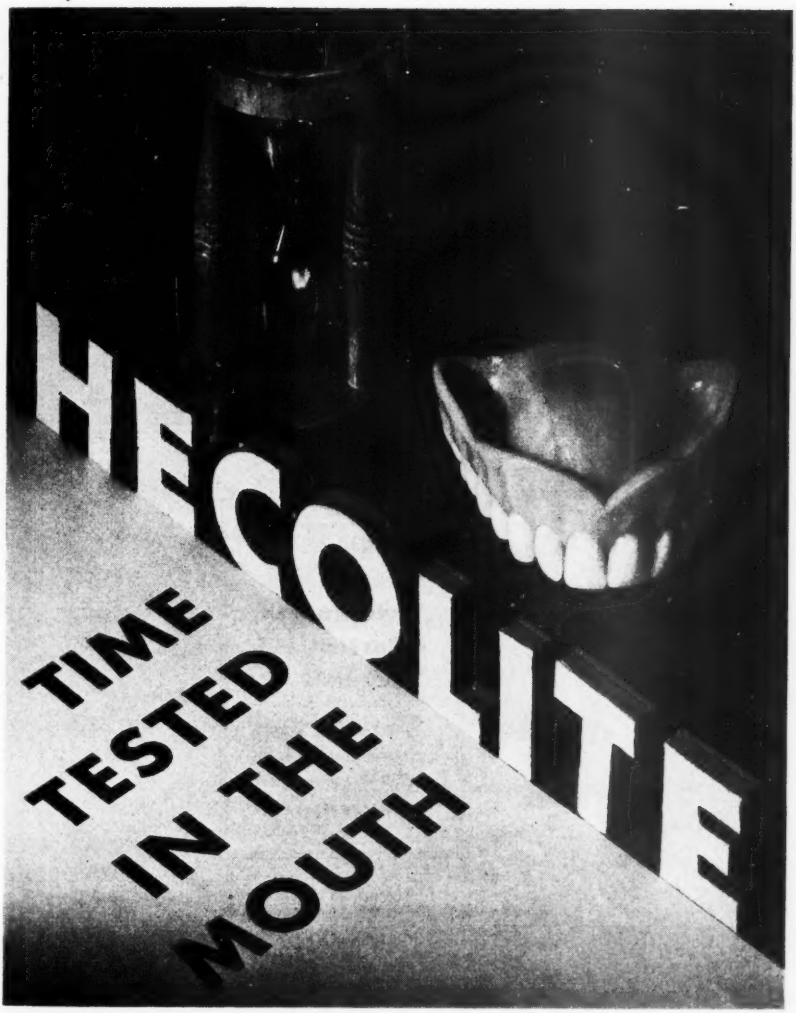

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Anestube Syringe	3.50
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Total Value	$15.50
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You Save	*4.00*

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100 Anestubes	$7.00
Anestube Syringe	2.50
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Package—six small tubes Novesthol Surgical Dressing	1.25
1 dz. 1″ Rustless Steel Needles	.75
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Why You Should Use Novol Metal-Cap Anestubes . . . . .

1—Novol Metal Cap Anestubes permit flaming of the puncturable diaphragm of the cartridge, so that the possibility of carrying contamination from an unsterile stopper into the tissues, is eliminated.

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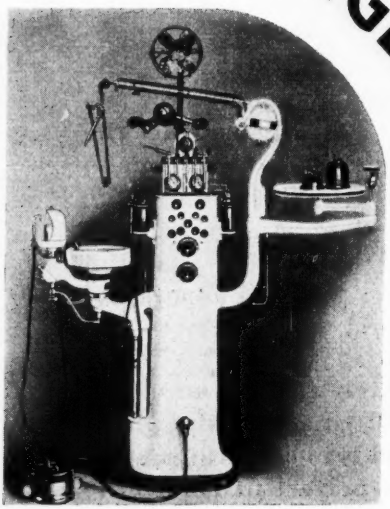

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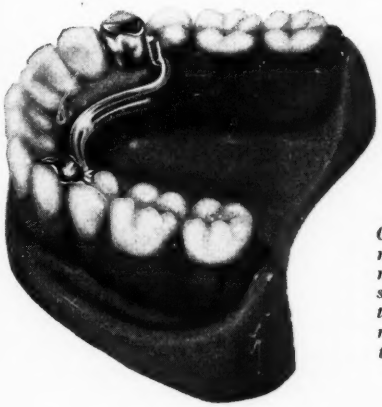

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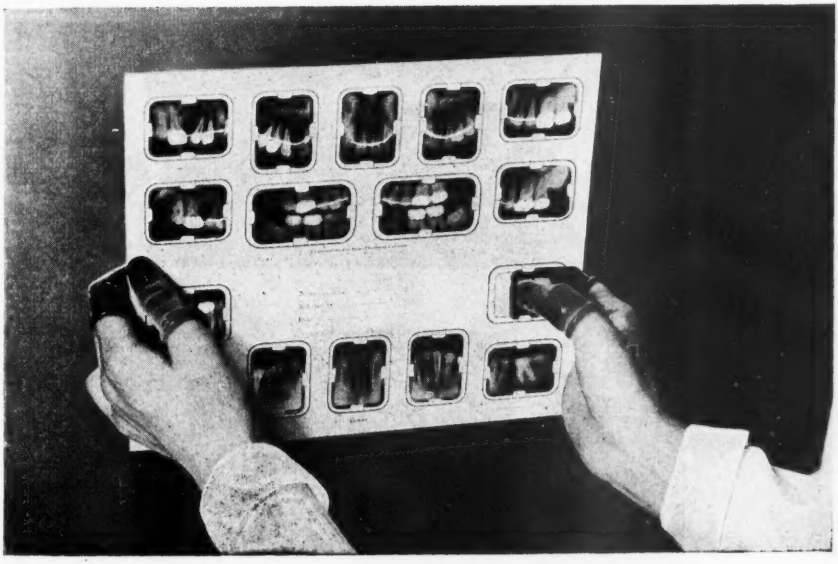

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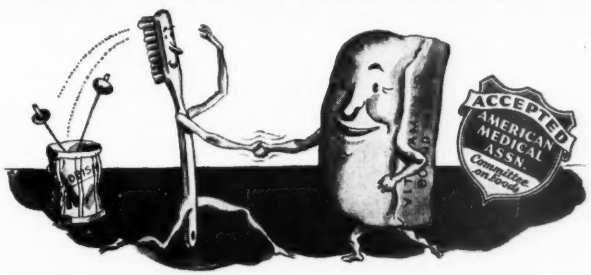

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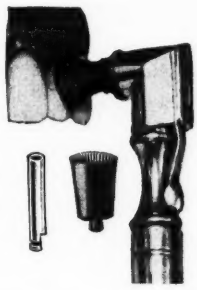

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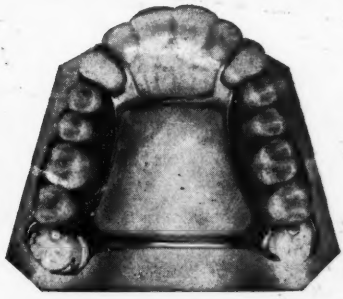

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